ECOLOGICAL ASSESSMENT OF VANDENBURG AIR FORCE BASE, CALIFORNIA

VOLUME II. BIOLOGICAL INVENTORY 1974/75

SAN DIEGO STATE UNIVERSITY

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VOLUME II
BIOLOGICAL INVENTORY 1974/75

CENTER FOR REGIONAL ENVIRONMENTAL STUDIES
SAN DIEGO STATE UNIVERSITY
SAN DIEGO, CALIFORNIA 92182

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This second volume of a three volume report presents the data base from a survey of terrestrial environmental conditions at Vandenberg AFB, California, carried out from July 1974 to June 1975. The study was undertaken to provide basic data for assessment of the environmental impact of the Space Transport System planned for Vandenberg AFB and for management of the land resources of the base. Details are given of the floral and faunal investigations, including locations, methods, and procedures.

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Narrative and tabular data are provided on climate, soils, aquatic resources, vegetation, and game and non-game vertebrates.

PREFACE

This final report was prepared by the Center for Regional Environmental Studies, San Diego State University, San Diego, California, under AFOSR Contract F44620-75-C0008, and was funded by Headquarters Space and Missile Organization (SAMSO). This work was accomplished under JON 21033E20. Major Rutherford C. Wooten, Jr., (AFCEC/EVP), was the Center Project Officer in Charge. This project was transferred from the Air Force Weapons Laboratory (AFWL), Kirtland AFB, New Mexico.

This report consists of three volumes: Volume I - Evaluation and Recommendations, Volume II - Biological Inventory 1974/1975, Volume III - Environmental Planning System. Volume III is to be published at a later date.

This technical report has been reviewed and is approved for publication.

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1. - INTRODUCTION

The biota of northern Santa Barbara County is of unusual interest to biogeographers. Many species appear to be limited in distribution in the vicinity of Vandenberg AFB: the broad flood plain valley of the Santa Maria, Sisquoc, and Cuyama Rivers seems to provide a geographical barrier to some species, as does the westward extension of the Santa Inez mountain range in south Vandenberg AFB. Thus the following assessment of the biota contains a rich variety of plant and animal species, potentially more diverse than any other area of coastal southern California. Combined with the occurrence of rare or unique plant communities (such as coastal salt marsh, bishop pine, and coastal dunes), the biological significance of the 94,702 acres of Vandenberg AFB is unquestionably of regional and national importance. As with many DOD land holdings, most requirements of the mission of the installation have been compatible with the conservation of ecological resources for the public. Specific knowledge of the requirements for perpetuation of these resources should therefore be the concern of land managers and land use planners of the Air Force.

This volume of the report is presented as a companion to Volume I (Evaluation and Recommendations). Thorough documentation of methods used in various biological sampling and analyses are given here. The descriptive prose is brief, with cross-references to the appropriate sections of Volume I. Primarily, organized tabulation of biological information is given here, which is self-explanatory. In summary, this volume contains the documentation (quantitative and qualitative) of the present biological conditions at Vandenberg AFB, based on our studies commencing in August 1974 and terminated in June 1975.

A limited number of sets of vegetational map overlays, keyed to the Base Master Plan Map Series C-1 (January 1971 Revision) was prepared. Each set consists of a series of 66 map sheets, on transparent acetate, delineating the vegetation types of the base as determined from aerial photo interpretation. These overlays may be examined at the following locations:

AFCEC/EVP
Tyndall AFB FL 32401

HQ SAMSO/DE
Los Angeles AFS CA 90009

4392 AEROSG/DEV
Vandenberg AFB CA 93437

2. - FRESH WATER AQUATIC STUDIES

2.1. Methods and Procedures

2.1.1. Preliminary Survey. A preliminary survey of the base was made in July and August of 1974. This survey examined the three major streams, San Antonio Creek, Cañada Honda Creek and the Santa Ynez River, and located a number of smaller streams. Of these, two, "Cañada del Norte" and Cañada del Jolloru, were picked to represent the watersheds of the extreme northern and extreme southern (Sudden Ranch area) portions of the base respectively. These five streams constituted the major focus for our analysis of stream ecosystems.

The survey also identified five major bodies of fresh water: Punchbowl Lake, Mod III Lake, Upper Canyon Lake, Middle Canyon Lake, and Lower Canyon Lake (Table 2.1.1). These lakes were the principal focus for our analysis of standing water ecosystems. The largest body of standing water, the Santa Ynez Lagoon, was not included in our major sampling base as it is normally brackish, but the lagoon was sampled periodically and certain aspects of its structure and dynamics were determined.

Many other bodies of standing water were located, of these only two were of significant size: Shuman Canyon Creek and "Joe's Lake". Table 2.1.2 presents a list of all permanent streams located on the base (permanent indicates that the streams contained running water in September 1974). and a number of temporary streams. The list also contains all bodies of standing water located during this period. The names given in the list are often those given to the stream or pond by ourselves, as many of these water systems were not named. For ease in location, coordinate numbers have been

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TABLE 2.1.1. Lakes and Ponds

	Coord.[1]	(M^2) Area	(M) Ave. Depth	(M^3) Approx Volume	(M) Length of Shore	(M) Max Depth Z_m
NORTHERN AREA						
Shuman Lagoon[2]	SA-124.1	--	--	--	--	
NORTH-CENTRAL AREA						
Santa Ynez Lagoon[2]	WA- 68.3	236,000	0.7*	165,000	8,900	3.0
Punchbowl Lake	RB- 95.1	55,000	0.9	49,500	1,600	1.6
Lower Canyon Lake	XB- 76.4	46,000	1.2	55,200	1,300	2.9
Middle Canyon Lake	VB- 79.3	42,000	1.8	75,600	900	4.3
Mod III Lake	YA-103.5	39,000	1.6	62,400	1,100	7.0
Upper Canyon Lake	UB- 81.7	23,000	1.3	50,531	870	2.6
Joe's Lake[3]	SA-100.3	16,000	1.2	19,200	600	2.0
El Rancho Pond	EB-100.9	9,000	0.8	7,200	300	1.3
Lompoc/Casmalia Pond[3]	IB- 96.6	9,000	0.6	5,166	300	1.2*
Salt Sink[3]	RB- 95.4	7,000	0.3	2,100	300	0.5*
San Antonio Lagoon[2]	OA-106.2	6,000	1.0	6,000	1,600	1.5*
Dune Pond[3]	TA-122.3	6,000	0.3	1,800	250	0.5*
Triangle Pond[3]	MB-101.2	5,000	0.4	2,000	400	0.7*
El Rancho Oeste Pond[3]	FB-109.4	3,750	0.2	750	270	0.4*
Barka II Pond[3]	JC- 95.1	2,000	--	--	200	--
Umbra Pond[3]	BB-104.4	720	0.5	360	200	0.8*
Barka I Pond[3]	EC- 98.9	300	0.3	90	150	0.5*
13th Street Pond[3]	GB- 86.8	150	0.2	30	60	0.4*
Tangair Ponds[4]	QA- 93.5	465	0.2*	93	92	0.5*
Bear Creek Pond[3,5]	SA- 54.9	4,500	0.3*	1,350	340	0.4*
SOUTH CENTRAL						
Honda Ridge Pond[3]	LA- 34.7	3,000	--	--	120	--
SOUTHERN						
Jolloru I Pond[3]	NB- 20.9	3,000	--	--	250	--
Jolloru II Pond[3]	PB- 20.2	2,000	--	--	180	--

1. Coord. from Base Master Plan Map series C-1 (1 Janaury 1971 Revision) 66 sheets, scale 1" = 60'.
2. Highly variable in area and depth depending on season and/or tide
3. Name given to site by investigator
4. Name given to a series of small temporary or semipermanant ponds; measurements given are for largest in series
5. Temporary

* estimates

TABLE 2.1.2. Streams

	Coord.[1,3]	(km) Length on Base	(km^2) Area of Watershed	(km) Total Length	(km^2) Total Watershed
NORTHERN AREA					
Cañada del Norte[2]	MA-140.9	3.5	2.8	3.5	2.8
Shuman Canyon Creek	AB-123.9	7.0	--	--	--
TOTALS		10.5	--		
NORTH-CENTRAL AREA					
San Antonio Creek	EC-98.4 EB-98.5 PA-106.4	18.0	71	45.2	400
Santa Ynez River	PB-64.9 HB-63.8	8.8	--	112.7	2390
TOTALS		26.8	--		
SOUTH CENTRAL AREA					
Santa Ynez River	PB-64.9 HB-63.8	8.8	--	112.7	2390
La Salle Canyon	MB-45.7	1.8	7.5	--	--
Bear Creek[4]	SA-53.5	4.0	--	4.0	--
Honda Creek	GB-35.6 NA-37.4 IA-38.5	13.5	30.5	--	--
TOTALS		28.1	--		
SOUTHERN AREA					
Agua Viña	WA-21.8	3.3	2.7	3.3	2.7
Cañada de Morida	GB-15.4	3.5	2.8	3.5	2.8
Water Canyon	DB-17.1	4.0	2.6	4.0	2.6
Cañada de Hyla[2]	WA-21.7	2.5	2.2	2.5	8.8
Cañada del Jolloru	QB-20.1 PB-16.9	4.5	8.8		
TOTALS		17.8	19.1		

1. Coord. from Base Master Plan Map series C-1 (1 January 1971 Revision) 66 sheets, scale 1" = 80'.
2. Name given to site by investigator
3. Coordinate numbers for streams indicate sites where samples were taken.
4. Temporary

given to all ponds and streams. In the case of the streams, coordinate numbers indicate sampling locations. The base has been divided into four areas on the basis of the characteristics of their respective freshwater resources; and this is the basis for the grouping in Table 2.1.2.

2.1.2. Sampling Regimes. A maximum of three sampling stations, each 50 m long, were set up on each of the streams in the base set. These stations were picked as far as practicable to represent: 1) the stream headwaters or where it enters the base, 2) the mid-point of the stream on the base, and 3) the outfall to the ocean. Three stations were set up on Cañada Honda Creek and San Antonio Creek, and one or two on the other streams (see Table 2.1.2 for location coordinates). As far as possible these stations were sampled in September, January and March. Variables measured included pH, conductivity, temperature, nitrate, phosphorous, discharge rate, suspended sediments, alkalinity, benthic invertebrates, depth and width. A verbal description was prepared for each stream sampling station; this described major plant species, plant cover, bottom type, vertebrates present and other items.

The five major lakes were also sampled in September, January and March. Variables measured included pH, conductivity, temperature, nitrate, phosphorous, dissolved oxygen (minimum dissolved oxygen was measured in September only), alkalinity, chlorophyll, transparency, depth, planktonic invertebrates and benthic invertebrates. Fish populations were sampled in March. A verbal description was made for each lake which noted major plant types, nature of basin, and other pertinent items.

2.1.3. Field and Laboratory Procedures. Conductivity was measured in the field with a Lab Line Lectro Mho-Meter and values corrected to 25° C. The pH was measured with a Beckman Model pH-180 meter buffered at pH 6.86 or

9.0. Transparency was measured with a Seechi disk. The alkalinity was measured in the field by titration of 25-100 ml samples with standard HCl to a bromcresol green end point; values were expressed as mg HCO_3^-/l. Nitrate and phosphorous samples were taken in 100 ml plastic vials, preserved with four drops of concentrated H_2SO_4 and analyzed later in the laboratory. Nitrate samples after neutralization to between pH 7 and 9 were analyzed by the method of Wood et al. (ref. 1). Measurement of total phosphorous was accomplished as described in Amer. Pub. Hlth. Assoc. (ref. 2), and consisted of a wet digestion with H_2SO_4 and HNO_3, with final determination by colorimetric measurement of the molybdenum blue-phosphorous complex. Dissolved oxygen was measured by the unmodified Winkler technique; minimum dissolved oxygen analyses were performed on samples taken at dawn. Chlorophyll samples consisted of 1 liter of water collected and analyzed within 48 hours. The sample was filtered through Whatman GF/C filter paper. The paper was ground in a tissue grinder with 5 ml of 90% acetone saturated with $MgCO_3$. The volume was made up to 10 ml with 90% acetone, centrifuged and absorbance measured with a spectrophotometer at 630, 645, 663, and 750 nm. The sample was then acidified and the absorbance measured at 663 and 750 nm. Spectrophotometer cells with a one centimeter light path were used. Concentrations of chlorophyll a, b and c, and chlorophyll a corrected for phaeopigments were determined using the equations of Strickland and Parsons (ref. 3).

Suspended sediments were measured by taking a 1 liter sample of water, preferably in an area of high current. The water was filtered through prewashed and weighed Whatman GF/C filter paper; these were dried at 100° C for 1 hour and reweighed. Suspended solids were calculated as the difference in weights of filter paper and included both organic and inorganic matter.

Discharge rates were estimated by timing a float over at least 1 meter of stream, thus estimating current rate in m/sec. The average depth and width in meters was estimated over the timed interval. Discharge rate was calculated from the equation average width x average length x current rate = volume in m^3/sec. Stream organisms were sampled with a rectangular net (1 mm mesh, 46 x 20 cm net opening) at five locations within the sample station. Samples were taken by dragging the net over the bottom on sluggish muddy bottom streams, or, in swifter streams, by turning rock and washing gravel over a measured area and allowing organisms to be washed into the net. The samples for each station were combined and, if possible, sorted alive that evening. Samples were identified and counted in the laboratory.

Plankton samples and water samples for chemical analysis were taken with a 2-meter long, 10 cm diameter sampling tube which had a bottom opening that could be closed from the surface. After water samples were taken, the remainder of the water was passed through a plankton net, and any organisms were collected and preserved.

Benthic invertebrates of the lakes were sampled with an Ekman dredge, up to five dredge hauls being taken per lake at various locations. Samples were combined and washed in the 1 mm mesh dip net used for collection of stream organisms, and treated and analyzed in the same manner as were the samples of stream benthos.

The fish of the five lakes were sampled during the period March 23-27, 1975 using a 65 foot, 1/2 inch mesh pocket seine. Two to four seine hauls were taken per lake, according to the lake's size and other conditions. All fish caught were identified, weighed, measured and scales removed for growth rate and age analysis. Selected fish were sacrificed for stomach analysis.

2.2. - Results

2.2.1. Chemical and Physical Parameters. The chemical and physical data are presented in Table 2.2.1. The pH of most waters is between 7.0 and 8.5. In September three measurements exceeded 8.5, Upper Canyon Lake, Punchbowl Lake, and Santa Ynez Lagoon. All three of these bodies of water were at that time subject to high levels of primary production which tends to raise pH levels. By January, when most primary production was at a low level, the pH of these waters was also between 7.0 and 8.5. Two small ponds, El Rancho Oeste and Lompoc-Casmalia were slightly acid with pH values of 6.7 and 6.3, respectively, in January 1975.

Conductivities were generally between 1000 and 6000 µmhos. A few bodies of water exceeded this range. The Santa Ynez Lagoon is brackish and had conductivities exceeding 12,000 µmhos in September and January. A small, shallow pond near Punchbowl Lake also had conductivities exceeding 12,000 µmhos. Shuman Canyon Creek and Cañada del Jolloru Station 1 exceeded 6000 µmhos. The reason for the high conductivities of these latter sites was not determined. Mod III Lake and Punchbowl Lake had the highest conductivities of any of the lakes: 5200 and 4150 µmhos, respectively, in September, 1974. These are both at least superficially closed basins and thus subject to evaporative concentration of salts. It is not known whether there is any water loss from their basins by seepage.

Alkalinities ranged mostly from 200-600 mg HCO_3^-/l. However, Punchbowl Lake had an alkalinity of 932 mg HCO_3^-/l in September 1974; this lake tends to trap salts and would be expected to have a high alkalinity. Two temporary ponds, El Rancho Oeste and Tangair Pond, had relatively low alkalinities, 63

TABLE 2.2.1 Selected Physical and Chemical Characteristics of Lakes and Streams on Vandenberg AFB

1. Streams

Name	Coord. No.	pH			Conductivity μ mhos at 25° C			Alkalinity mg HCO_3^-/l			Total Phosphorous mg/l	Nitrate Nitrogen mg/l		Discharge m^3/sec x 10^3			Suspended Sediment mg/l ①		Water Temp °C			Air Temp °C		
		9/74	1/75	3/75	9/74	1/75	3/75	9/74	1/75	3/75	9/74	9/74	1/75	9/74	1/75	3/75	9/74	1/75	9/74	1/75	3/75	9/74	1/75	3/75
"Canada del Norte"	MA-140.9	8.2	8.0	8.3	3930	3900	3640	378	406	500	0.37	0.81	0.23	37	6	11	155	38	20.4	12.0	7.0	20.4	15.5	9.0
Shuman Canyon	AB-123.9	7.9	8.0	7.8	4680	6650	4180	527	527	295	1.3	0.64	4.27	36	27	81	--	7	15.5	11.0	9.0	16.5	13.0	12.5
San Antonio Creek Sta. 1	EC- 98.4	7.6	7.2	7.4	1600	2210	2080	425	411	446	0.89	3.45	1.37	--	9	369	<20	44	20.0	12.0	9.0	24.5	15.5	11.0
San Antonio Creek Sta. 2	EB- 98.5	8.0	7.8	7.7	3650	2720	1900	644	512	492	1.4	8.21	10.9	②	②	②	<20	39	23.0	10.0	10.0	21.0	13.5	12.0
San Antonio Creek Sta. 3	PA-106.4	7.4	--	7.8	1175	--	2600	217	--	440	1.1	2.14	--	29	--	--	9	--	17.5	--	12.0	19.1	--	13.0
Santa Ynez River Sta. 1	PB- 64.9	7.3	7.5	8.2	2090	1960	1030	499	350	294	1.6	0.37	6.2	38	--	--	<20	36	18.5	14.5	12.5	18.5	16.0	10.0
Santa Ynez River Sta. 2	HB- 63.8	7.8	7.8	7.9	3420	2000	1070	--	370	296	0.16	37.9	16.1	②	--	--	--	9	--	15.0	12.0	--	17.0	14.0
Bear Creek	SA- 53.5	--	--	7.6	--	--	1430	--	--	197	--	--	--	--	--	--	--	--	--	--	12.0	--	--	14.0
La Salle Canyon	MB- 45.7	7.7	7.5	--	1660	1690	--	477	545	--	0.03	0.06	--	--	5.4	--	--	9	15.0	--	--	18.0	--	--
Canada Honda Creek Sta 1	GB- 35.6	7.8	7.8	7.8	1810	2200	1375	454	485	319	0.12	0.14	0.06	--	15	303	<20	2	20.0	6.0	9.5	20.0	12.0	12.0
Canada Honda Creek Sta 2	NA- 37.4	8.2	7.8	7.7	1690	1810	1360	397	425	368	0.06	0.03	0.08	51	17	--	1	7	15.0	9.0	11.0	14.5	14.0	13.0
Canada Honda Creek Sta 3	IA- 38.5	8.2	7.7	8.0	1760	1860	1460	414	435	337	0.13	0.10	0.03	74	26	275	--	5	16.5	11.0	13.0	16.8	15.0	15.0
Agua Vina	WA- 21.8	7.8	8.1	8.3	1930	1750	1100	466	306	211	0.57	0.12	0.14	--	1.5	--	123	12	23.0	15.0	17.0	16.5	15.0	14.5
Canada de Morida	GA- 15.4	--	8.0	8.6	--	1850	1410	--	362	446	--	--	--	--	1.4	6	--	40	--	16.0	16.5	--	17.0	15.0
Water Canyon	DB- 17.1	--	7.9	8.4	--	3250	1970	--	222	405	--	--	--	--	0.8	3	--	12	--	15.5	17.0	--	15.5	14.0
"Canada de Hyla"	WA- 21.7	--	8.3	--	--	2420	--	--	314	--	--	--	--	--	0.5	--	--	43	--	15.0	--	--	15.5	--
Canada del Jolloru Sta. 1	QB- 20.1	7.1	7.4	--	8100	7150	--	470	410	--	--	0.03	0.20	26	0.6	--	--	15	15.5	12.0	--	14.0	18.0	--
Canada del Jolloru Sta. 2	PB- 16.9	8.0	7.4	8.0	2680	2920	3280	457	422	506	0.06	0.11	0.25	26	7	11	--	18	16.0	12.0	11.5	17.2	18.5	13.5

2. Lakes and Ponds

Name	Coord. No.	pH			Conductivity ③ μ mhos at 25° C.			Alkalinity mg HCO_3^-/l			Total Phosphorous mg/l	Nitrate Nitrogen mg/l		Secchi disk (M)			Dissolved O_2 (mg/l)			Surface Temp. (°C)			Air Temp. (°C)		
		9/74	1/75	3/75	9/74	1/75	3/75	9/74	1/75	3/75	9/74	9/74	1/75	9/74	1/75	3/75	9/74	1/75	3/75	9/74	1/75	3/75	9/74	1/75	3/75
"Tangair Pond"	CA- 93.5	--	--	8.6	--	--	1930	--	--	86	--	--	--	--	--	>.5	--	--	--	--	--	--	--	--	--
"Dune Pond"	TA-122.3	--	7.3	--	--	1570	--	--	351	--	--	--	--	--	--	--	--	--	--	--	15.0	--	--	15.0	--
"El Rancho Oeste Pond"	FE-109.4	--	6.7	--	--	420	--	--	63	--	--	--	0.37	--	--	--	--	--	--	--	15.0	--	--	16.0	--
"Mallard Pond"	MB-101.2	--	7.1	--	--	1500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
El Padro Pond	EB-100.9	--	7.2	--	--	4800	--	--	--	--	--	--	0.09	<0.1	--	--	--	--	--	--	--	--	--	--	--
"Lompoc-Casmalia Pond"	IB- 96.6	--	6.3	--	--	1000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
"Burke 1 Pond"	EC- 98.9	--	7.6	--	--	2400	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
San Antonio Lagoon	OA-106.2	8.2	--	7.9	1510	--	2600	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mud III Lake	YA-103.5	8.1	7.7	--	5200	4500	4050	491	470	--	0.94	0.15	0.80	2.3	2.4	1.2	8.44	9.4	--	22.0	8.5	16.0	20.0	10.5	14.0
Punchbowl Lake	RB- 95.1	8.8	7.9	--	4150	4650	3420	932	915	--	2.34	0.09	0.98	1.0	0.9	0.4	8.57	8.92	7.50	23.0	9.5	14.0	17.5	14.0	--
Upper Canyon Lake	UB- 81.7	9.1	7.1	--	2300	1290	1120	331	171	--	0.51	0.07	0.35	--	0.2	--	6.83	6.69	7.02	--	9.0	15.0	--	11.0	15.0
Middle Canyon Lake	MB- 79.3	8.2	7.2	--	1750	1610	1210	284	260	--	1.24	0.05	0.33	3.0	0.8	0.5	7.68	10.42	8.89	--	9.2	15.0	--	13.0	--
Lower Canyon Lake	AB- 75.4	--	7.8	--	2100	2170	1430	432	395	--	1.48	0.34	0.25	0.8	1.0	0.5	6.69	10.58	--	26.0	9.5	--	20.0	12.0	--
"Mabel's Lake"	SA-100.3	7.6	7.1	--	2340	1700	2000	267	--	--	1.48	0.05	--	--	--	--	7.63	--	--	16.8	--	--	--	--	--
Santa Ynez Lagoon	WA- 63.3	8.9	8.4	--	13900	30000	--	378	280	--	0.75	0.14	--	0.08	0.3	--	--	16.58	--	17.0	--	--	16.0	--	--
"Bear Creek Pond"	SA- 54.9	--	--	8.2	--	--	2040	--	--	404	--	--	--	--	--	>.5	--	--	--	--	--	--	--	--	--
"Honda Ridge Pond"	LA- 34.7	--	--	8.2	--	--	970	--	--	291	--	--	--	--	--	--	--	--	--	--	--	15.0	--	--	15.0

① <20 was reported in some cases since detection limits for initial samples were about 20 mg/l, detection limits of subsequent samples were about 1 mg/l.

② Current was too slow to measure discharge by method used.

③ Total dissolved solids in ppm is approximately equal to 0.7 x conductivity in μ mhos.

and 86 mg HCO_3^-/l, respectively, probably because these ponds are generally filled with rain water. Most of the water on the base can be considered as hard water.

Water temperatures varied from 6.0° C. at Cañada Honda Creek in January 1975 to 26° C for Lower Canyon Lake in September 1974. Generally, the low point in water temperature was in January or February with the temperature of the lakes less than 10° C (50° F.), while the streams were between 10 and 15° C September probably was the month of maximum water temperatures. The streams and lakes varied from 15° C to 26° C; streams were generally less than 20° C, while the lakes were generally warmer.

The discharge rates are approximate but can be used to demonstrate seasonal and between-stream differences. January was the month of lowest discharge rates while March had the highest discharge rates. Cañada Honda Creek and San Antonio Creek had the highest March discharge rates of all the streams measured. With the exception of the Santa Ynez River, which was not measured, in March, these two streams have larger watersheds than any others on the base. The measured discharge rates were not affected by recent storm runoff.

Nitrate levels were generally high in all waters sampled except Cañada Honda Creek and La Salle Canyon. These latter streams are not subject to extensive agriculture pollution, whereas San Antonio Creek, the Santa Ynez River and Shuman Canyon do receive extensive runoff from agriculture land, most of which occurs off of the base, and have correspondingly high nitrate concentrations (1.4 to 37.9 mg N - NO_3/l).

The phosphorous levels of the water of the base are also generally quite high, high enough that phosphorous, which is the limiting nutrient for the

growth of plants in most natural aquatic systems, is not at all limiting in the principal aquatic systems of the base. Phosphorous is also an agriculture pollutant but is generally not as concentrated in agricultural runoff as is nitrate. This is reflected in the comparison of total phosphorous and nitrate levels for San Antonio Creek (see Table 2.2.1). The P concentrations in the lakes (0.5 - 2.34 mg/l) represent a very high level for non-polluted waters. The source of these high levels is unknown.

Chlorophyll a levels of the lakes were generally low in September and January and slightly higher in March, especially in Punchbowl Lake. These results agreed well with field observations of water color. Measurements indicated that chlorophyll c, at least in January and March, had higher concentrations than chlorophyll a. This may indicate that the dominant algae at these times were diatoms; though the high level of phaeophytin and other degradation products may have caused an unusually high value for chlorophyll c (see Table 2.2.2). Santa Ynez Lagoon had a very high chlorophyll a level in September, 1974 (894 mg/l), when the lagoon was in the middle of an extensive bloom of the blue-green algae *Nodularia* sp.

Secchi disk readings never exceeded three meters and were often less than one meter. The lowest readings were taken in March when the lakes had high levels of silt. The reason for the poor transparency in other sampling periods was not determined. Phytoplankton levels were low and measurement of absorption spectras for visible wavelengths of plankton-free water failed to show any significant absorbtion.

Oxygen levels were somewhat variable ranging from 2.36 mg/l (minimum dissolved O_2 in San Antonio Creek) to 10.58 mg/l in Lower Canyon Lake. Percent saturation varied from 25% (San Antonio Creek) to 98% in Punchbowl Lake (see Tables 2.2.3 and 2.2.4).

TABLE 2.2.2. Concentrations of Various Chlorophylls

	Chl a mg/l			Chl b mg/l			Chl c mg/l		
Source	Sept	Jan	Mar	Sept	Jan	Mar	Sept	Jan	Mar
Upper Canyon Lake	1.1	2.7	--	--	5.0	4.5	--	20.2	16.4
Middle Canyon Lake	2.8	4.3	4.8	--	3.0	4.4	--	8.9	13.1
Lower Canyon Lake	--	3.3	4.8	--	3.8	2.6	--	12.8	7.5
Punchbowl Lake	4.9	1.0	23.5	--	2.1	8.6	--	9.4	32.6
Mod III Lake	4.2	0.5	8.2	--	5.7	1.9	--	15.9	8.9

TABLE 2.2.3. O_2 Concentrations and Percent Saturation

	Sept		Jan		March	
Lake	O_2 mg/l	% Satd.	O_2 mg/l	% Satd.	O_2 mg/l	% Satd.
Upper Canyon Lake	6.83	83%*	6.69	58%	7.02	69%
Middle Canyon Lake	7.68	94%*	10.42	90%	8.88	83%
Lower Canyon Lake	6.69	82%	10.58	92%	--	--
Punchbowl Lake	8.57	98%	8.92	78%	7.50	72%
Mod III Lake	8.44	96%	9.4	80%	--	--

*Temperature of water assumed to be 26° C.

TABLE 2.2.4 Minimum Dissolved O_2, September, 1974

	mg/l	% Satd.
San Antonio Creek Station 2	2.36	25%
Upper Canyon Lake	5.53	59%
Middle Canyon Lake	5.77	66%
Punchbowl Lake	6.58	73%

2.2.2. Aquatic Plant Life. Tables 2.2.5 and 2.2.6 are, respectively, lists of riparian and aquatic plants noted and identified during field analysis of the various aquatic sites. Tables 2.2.7 and 2.2.8 are lists of plants by sampling sites for riparian and aquatic plants, respectively. No attempts were made to identify all species at each site and the list generally includes only the dominant plants present. Plant identifications were according to Murry and Keck's terminology (ref. 4). This does not necessarily mean that they were abundant at a site; if a site had little plant cover, even the dominants would have low abundance. *Batrachospermus*, an encrusting red alga of streams, is an example of this. As the lists are very incomplete, they are presented more as guides for future plant analyses of the aquatic systems of Vandenberg AFB than as a true structure of the aquatic plant communities.

Willow (*Salix* spp.) was by far the dominant riparian species occurring at nearly every site. Of the aquatic vascular plants, reeds, especially *Scirpus* sp. and *Typa* sp. were the most common, while watercress (*Nasturtium officinale*) and Duckweed (*Lemna minor*) were present at many locations, often in dense stands.

2.2.3. Invertebrates. The invertebrate fauna found in the streams, lakes and ponds of Vandenberg AFB in September 1974 are enumerated below. Tables 2.2.9 and 2.2.10 present the results of quantitative samples taken at our stream sampling stations; Table 2.2.9 lists the insects and Table 2.2.10 lists the other invertebrates. Table 2.2.11 presents the results of the quantitative samples of the benthic invertebrates taken from the lakes. Table 2.2.12 presents the results of the quantitative samples of the planktonic invertebrate of the Canyon Lakes. Table 2.2.13 is a compilation of all aquatic invertebrates found on the base and the locations where they were found.

TABLE 2.2.5. Riparian Plants, Division Anthophyta

	Common Name	Location*
Apiastrum angustifolium	Wild celery	1,2,4
Baccharis sp.	-----	4,6,15,16,17
B. Douglasii	-----	3,15,16,17
Brassica sp.	Mustard	2,4,5,15,16,17
Caulanthus californicus	-----	8
Chenopodium sp.	Goosefoot or Pigweed	4,5,8,16
Conium maculatum	Poison hemlock	4,8,15,17,27
Eriophyllum staechadifolium	-----	3
Eucalyptus sp.	Eucalyptus	2,23,27
Gnaphalium luteo-album	Cudweed or Everlasting	8
Helenium Bolanderi	Sneezeweed	2,4
Heliotropium curassavicum var. oculatum	Helitrope	4
Jaumea carnosa	-----	3
Lepidium campestre	Cow Cress	8
Melilotus alba	Sweet clover	1,2,8
M. indicus	Sweet clover	1,2,3,8
Perezia microcephala	-----	3
Polypogon monspeliensis	Beard grass	2,7,8,9,10
Quercus sp.	Oak	12,14,27
Ribes sp.	Current or Gooseberry	1
Rubus ursinus	California blackberry	1,2,3,27
Rumex sp.	Dock or Sorrel	5,8,12,16,17
R. feuginus	Golden dock	7
Salvia sp.	Sage	10
Salix sp.	Willow	most locations
Sambucus sp.	Elderberry	4,10
Satureja Douglasii	Yerba buena	1
Solanum sp.	Nightshade	16
Toxicodendron diversiloba	Poison oak	2,16,20,23
Urtica holosericea	Nettle	1,4,5,6,8,12,16,27,30
Veronica americana	Brooklime	8
Various short grasses	-----	9,11,30

*See Table 2.2.7. for explanation of numbers.

TABLE 2.2.6. Aquatic Plants

	Common Name	Location*
ALGAE		
Division Bacillariophyta	Diatoms	
Bacillaria sp.		20
Campylodiscus sp.		13,15,20
Coscinodiscus sp.		14
Cyclotella sp.		17
Gyrosigma sp.		17
Suriella sp.		13,14,15,16,20
Division Charaphyta		
Chara sp.	Stone wort	3
Division Chlorophyta	Green algae	
Chlorococcum sp		Streams
Microspora sp.		15
Oedogonium sp.		19
Rhizoclonium sp.		10
Enteromorpha sp.		3,6,9,10,21
Spirogyra sp.		Lakes
Stigeoclonium sp.		26
Ulothrix sp.		Sewage treatment plant
Division Chrysophyta		
Vaucheria sp.		18
Division Cyanophyta	Blue green algae	
Nodularia sp.		22
Lyngbya sp.		Sewage treatment plant
Division Euglenophyta	Eulglenoids	
Colacium sp.		Lakes
Division Rhodophyta	Red algae	
Batrachospermum sp.		1
VASCULAR PLANTS		
Division Calamophyta	Horsetails	
Equisetum Telmatia var. Braunii	Giant horsetail	1,2
Division Pterophyta	Ferns	
Azolla filiculoides		6,7,8
Marsilea sp.		20,23
Division Anthophyta	Flowering plants	
Cotula coronopifolia	Brass buttons	5,16
Cyperus Eragrostis	Umbrella sedge	7,8
Helenium Bolanderi	Sneezeweed	6
Juncus sp.	Rush or Wire grass	3,12,16
J. Lesueurii		6
J. oxymeris		2

TABLE 2.2.6. cont.

	Common Name	Location*
Division Anthophyta cont.		
Lemna minor	Duckweed	4,5,7,8,13,18,23,25
Nasturtium officinale	Watercress	1,3,4,5,6,7,8,23,30
Potamogeton sp.	Pondweed	3,6,7,12,13,15,16,20
Sagittaria sp.	Arrowhead	16
Scirpus sp.	Bulrush or Tule	9,10,11,18,19,20,23,24,25,26
S. acutus	Common tule	3,4,5
S. americanus	Three square	3,4,12
S. californicus	California bulrush	6,12,13,14,15,16,17,20
S. microcarpus		7,8
S. robustus		3,5,7,8,14,15,16,20
Sparganium eurycarpum	Bur reed	1,4,5,6,20
Typha sp.	Cattail	6,14,18,23,24,25,26
T. domingensis		7
T. latifolia	Soft flag	4,5,7,12,13,29

*See Table 2.2.8. for location number identification.

TABLE 2.2.7. List of Riparian Plants by Site

San Antonio Creek Station 1

Apiastrum angustifolium
Baccharis sp.
Brassica sp.
Chenopodium sp.
Conium maculatum
Helenium Bolanderi
Heliotropium curassavicum var. oculatum
Salix sp.
Sambucus sp.
Urtica holosericea

San Antonio Creek Station 2

Brassica sp.
Chenopodium sp.
Conium maculatum
Rumex sp.
Salix sp.
Urtica holosericea

San Antonio Creek Station 3

Baccharis sp.
Salix sp.
Urtica holosericea

Santa Ynez River Station 1

Polypogon monspeliensis
Rumex fueginus
Salix sp.

Santa Ynez River Station 2

Chenopodium sp.
Conium maculatum
Caulanthus californicus
Gnaphalium luteo-album
Lepidium campestre
Melilotus alba
M. indicus
Polypogon monspeliensis
Rumex sp.
Salix sp.
Urtica holosericea
Veronica americana

Cañada Honda Creek Station 1

Apiastrum angustifolium
Melilotus alba
M. indicus
Ribes sp.
Rubus ursinus
Salix sp.
Satureja Douglasii
Urtica holosericea

TABLE 2.2.7. cont.

Cañada Honda Creek Station 2
- *Apiastrum angustifolium*
- *Brassica sp.*
- *Eucalyptus sp.*
- *Helenium Bolanderi*
- *Melilotus alba*
- *M. indicus*
- *Polypogon monspeliensis*
- *Rubus ursinus*
- *Salix sp.*
- *Toxicodendron diversiloba*

Cañada Honda Creek Station 3
- *Baccharis Douglasii*
- *Eriophyllum staechadifolium*
- *Jaumea carnosa*
- *Melilotus indicus*
- *Perezia microcephala*
- *Rubus ursinus*
- *Salix sp.*

Cañada del Jollorou Station 1
- *Polypogon monspeliensis*
- *Salix sp.*
- unidentified grasses

Cañada del Jollorou Station 2
- *Polypogon monspeliensis*
- *Salvia sp.*
- *Salix sp.*
- *Sambucus sp.*

Canada del Norte
- *Salix sp.*
- unidentified grasses

Upper Canyon Lake
- *Salix sp.*

Middle Canyon Lake
- *Quercus sp.*
- *Salix sp.*

Lower Canyon Lake
- *Quercus sp.*
- *Rumex sp.*
- *Salix sp.*
- *Urtica holosericea*

TABLE 2.2.7. cont.

Mod III Lake
Baccharis sp.
Baccharis Douglasii
Brassica sp.
Chenopodium sp.
Eucalyptus
Rumex sp
Salix sp.
Solanum sp.
Toxicodendron diversiloba
Urtica holoserica

Punchbowl Lake
Baccharis sp.
Baccharis Douglasii
Conium maculatum
Salix sp.

"Joe's" Lake
Baccharis sp.
B. Douglasii
Conium maculatum
Rumex sp.
Salix sp.

Agua Viña
Urtica holosericea
various grasses

El Rancho Pond
Toxicodendron diversiloba

Lompoc Casmalia Pond
Salix sp.

Triangle Pond
Salix sp.

Umbra Pond
Eucalyptus sp.
Salix sp.
Toxicodendron diversiloba

El Rancho Oeste Pond
Salix sp.

Barka I Pond
Salix sp.

Dune Pond
Salix sp.

La Salle Canyon
Conium maculatum
Eucalyptus sp.
Quercus sp.
Rubus ursinus
Salix sp.
Urtica holosericea

Shuman Canyon
Salix sp.

TABLE 2.2.8. List of Aquatic Plants by Site

San Antonio Creek Station 1

Lemna minor
Nasturtium officinale
Scirpus acutus
S. americanus
Sparganium eurycarpum
Typha latifolia

San Antonio Creek Station 2

Cotula coronopifolia
Lemna minor
Nasturtium officinale
Scirpus acutus
S. robustus
Sparganium eurycarpum
Typha latifolia
unidentified filamentous algae

San Antonio Creek Station 3

Azolla sp.
Enteromorpha sp.
Helenium Bolanderi
Juncus Lesueurii
Nasturtium officinale
Potomogeton sp.
Scirpus californicus
Sparganium eurycarpum
Typha sp.

Santa Ynez River Station 1

Azolla sp.
Cyperus Eragrostis
Lemna minor
Nasturtium officinale
Scirpus microcarpus
S. robustus
Typha domingensis
T. latifolia
unidentified filamentous algae

Santa Ynez River Station 2

Azolla sp.
Cyperus Eragrostis
Lemna minor
Nasturtium officinale
Scirpus microcarpus
S. robustus

Canada Honda Creek Station 1

Batrachospermum sp.
Equisetum Telmatia var. Braunii
Nasturtium officinale
Sparganium eurycarpum

TABLE 2.2.8. cont.

Cañada Honda Creek Station 2
Equisetum Telmatia var.Braunii
Juncus oxymeris

Cañada Honda Creek Station 3
Chara sp.
Enteromorpha sp.
Juncus sp.
Nasturtium officinale
Potomogeton sp.
Scirpus acutus
S. americanus
S. robustus

Cañada del Jollorou Station 1
Enteromorpha sp.
Scirpus sp.

Cañada del Jollorou Station 2
Enteromorpha sp.
Rhizoclonium sp.
Scirpus sp.

Cañada del Norte
Scirpus sp.

Upper Canyon Lake
Lemna minor
Potomogeton sp.
Scirpus californicus
Typha latifolia
unidentified filamentous algae

Middle Canyon Lake
Scirpus californicus
S. robustus
Typha sp.
unidentified filamentous algae

Lower Canyon Lake
Juncus sp.
Potomogeton sp.
Scirpus americanus
S. californicus
Typha latifolia
unidentified filamentous algae

Mod III Lake
Cotula coronopifolia
Potomogeton sp.
Juncus sp.
Sagittaria sp.
Scirpus californicus
S. robustus

TABLE 2.2.8. cont.

Punchbowl Lake
Potomogeton sp.
Scirpus californicus
S. robustus
unidentified filamentous algae

"Joe's" Lake
Scirpus californicus

Agua Viña
Nasturtium officinale

El Rancho Pond
Marsilea sp.
Potomogeton sp.
Sparganium eurycarpum
Scirpus californicus
S. indicus
S. robustus

Lompoc Casmalia Pond
Lemna minor
Scirpus sp.
Typha sp.
unidentified filamentous algae

Triangle Pond
Scirpus sp.

Umbra Pond
Lemna minor
Marsilea sp.
Nasturtium officinale
Scirpus sp.
Typha sp.

El Rancho Oeste Pond
Scirpus sp.
Typha latifolia

Barka I Pond
Scirpus sp.
Typha sp.

Dune Pond
Lemna minor
Scirpus sp.
Typha sp.

Tangair Pond
Scirpus sp.
Typha sp.
unidentified filamentous algae

TABLE 2.2.9. Counts of Insects from Major Streams of Vandenberg Air Force Base, California, September, 1975 (#/m²)

	San Antonio Station 1	San Antonio Station 2	San Antonio Station 3	Santa Ynez Station 1	Santa Ynez Station 2	Canada Honda Creek Sta. 1	Canada Honda Creek Sta. 2	Canada Honda Creek Sta. 3	Canada del Jolloru Sta. 1	Canada del Jolloru Sta. 2	Canada del Norte	No. of Sites
Coleoptera	--	1.4	--	2.9	11	15	31	35	163	29	4.3	9
Dysticidae	--	--	--	--	--	11	31	26	76	26	--	5
Agabus sp.	--	--	--	--	--	4.3	--	4.3	--	--	--	2
Bidessus sp.	--	--	--	--	--	--	--	1.4	--	--	--	1
Derocanthcs sp.	--	--	--	--	--	--	31	--	--	--	--	1
Hydroporus sp.	--	--	--	--	--	--	--	--	11	--	--	1
Ilybius sp.	--	--	--	--	--	--	--	--	5.7	--	--	1
Laccophilus sp.	--	--	--	--	--	--	--	--	8.6	--	--	1
Oreodytes sp.	--	--	--	--	--	--	--	4.3	--	--	--	1
Others	--	--	--	--	--	7.1	--	16	51	26	--	3
Haliplidae	--	--	--	--	--	4.3	--	2.9	--	--	--	2
Peltodytes sp.	--	--	--	--	--	4.3	--	2.9	--	--	--	2
Hydrophilidae	--	1.4	--	--	--	--	--	5.7	84	1.4	4.3	5
Berosus sp.	--	--	--	--	--	--	--	1.4	30	--	--	2
Tropisternus sp.	--	--	--	--	--	--	--	4.3	54	--	--	2
Other	--	1.4	--	--	--	--	--	--	--	1.4	4.3	3
Psephenidae	--	--	--	--	--	--	--	--	--	1.4	--	1
Unidentified Coleoptera	--	--	--	2.9	11	--	--	--	2.9	--	--	3
Diptera	22	372	2.9	67	24	1.4	37	200	200+	47	77	11
Chironomidae	11	358	--	67	24	--	--	171	200+	37	76	8
Chironomus sp.	--	334	--	21	23	--	--	--	--	--	66	4
Pentaturu sp.	1.4	--	--	--	--	--	--	10	--	--	--	2
Metriocnemos sp.	2.9	20	--	17	1.4	--	--	161	--	34	--	6
Other	7.1	4.3	--	29	--	--	--	--	--	2.9	10	5
Culicidae	1.4	10	--	--	--	--	--	--	--	4.3	1.4	4
Dixidae	--	--	--	--	--	--	1.4	--	--	--	--	1
Paradixa sp.	--	--	--	--	--	--	1.4	--	--	--	--	1
Dolichopodidae	--	--	--	--	--	--	2.9	--	--	--	--	1
Empididae												
Roederiodes sp.	--	--	--	--	--	--	1.4	--	--	--	--	1
Heleidae	1.4	--	--	--	--	--	--	--	--	--	--	1
Muscidae	--	--	--	--	--	--	--	13	--	--	--	1
Limnophora sp.	--	--	--	--	--	--	--	13	--	--	--	1
Simuliidae	--	--	--	--	--	--	31	--	--	--	--	1
Stratiomyidae	--	--	--	--	--	--	--	--	2.9	--	--	1
Stratiomys sp.	--	--	--	--	--	--	--	--	2.9	--	--	1
Tipulidae	--	--	--	--	--	--	--	5.7	--	5.7	--	2
Hexatoma sp.	--	--	--	--	--	--	--	1.4	--	--	--	1
Dicranota sp.	--	--	--	--	--	--	--	4.3	--	5.7	--	2
Other Diptera	--	4.3	2.9	--	--	1.4	--	--	--	--	--	3
Ephemeroptera	1.4	16	--	2.9	1.4	1.4	30	57.6+	8.6	11	--	9
Baetidae	1.4	16	--	2.9	1.4	1.4	30	49	8.6	11	--	9
Tricorythodes fallax	--	--	--	--	--	--	--	49	--	--	--	1
Other	1.4	16	--	2.9	1.4	1.4	30	--	8.6	11	--	8
Siphlonuridae	--	--	--	--	--	--	--	yes	--	--	--	1
Other Ephemeroptera	--	--	--	--	--	--	--	8.6	--	--	--	1
Hemiptera	295	223	1.4	1.4	53	2.8	14.6	2.9	7.1	5.7	1.4	11
Belostomatidae	--	--	--	--	--	1.4	--	2.9	--	4.3	1.4	4
Corixidae	295	223	--	1.4	53	1.4	5.7	--	1.4	--	--	7
Corisella decolor	13	110	--	1.4	17	--	--	--	--	--	--	4
Sigara sp.	256	113	--	--	36	1.4	--	--	1.4	--	--	5
Other	26	--	--	--	--	--	5.7	--	--	--	--	2

TABLE 2.2.9. cont.

	San Antonio Station 1	San Antonio Station 2	San Antonio Station 3	Santa Ynez Station 1	Santa Ynez Station 2	Canada Honda Creek Sta. 1	Canada Honda Creek Sta. 2	Canada Honda Creek Sta. 3	Canada del Jolloru Sta. 1	Canada del Jolloru Sta. 2	Canada del Norte	No. of Sites
Gerridae	--	--	--	--	--	--	8.5	--	--	--	--	1
Gerris sp.	--	--	--	--	--	--	1.4	--	--	--	--	1
Trepobates beeki	--	--	--	--	--	--	7.1	--	--	--	--	1
Veliidae	--	--	--	--	--	--	1.4	--	--	1.4	--	2
Notonectidae	--	--	1.4	--	--	--	--	--	5.7	--	--	2
Notonecta sp.	--	--	1.4	--	--	--	--	--	5.7	--	--	2
Odonata	--	--	--	--	--	2.9	--	--	10	23	20	4
Cordulegastidae	--	--	--	--	--	--	--	--	--	--	--	
Cordulegaster dorsalis	--	--	--	--	--	2.9	--	--	--	--	--	1
Coenagrionidae	--	--	--	--	--	--	--	--	10	--	--	1
Hyponeura sp.	--	--	--	--	--	--	--	--	2.9	--	--	1
Ischnura sp.	--	--	--	--	--	--	--	--	5.7	--	--	1
Libellulidae	--	--	--	--	--	--	--	--	1.4	--	--	1
Pseudoleon sp.	--	--	--	--	--	--	--	--	1.4	--	--	1
Other Odonata	--	--	--	--	--	--	--	--	--	23	20	2
Plecoptera	--	--	--	--	--	5.8	21.3	254	--	4.3	--	4
Nemouridae	--	--	--	--	--	5.8	17	254	--	4.3	--	4
Nemoura sp.	--	--	--	--	--	5.8	17	254	--	--	--	3
Other Plecoptera	--	--	--	--	--	--	4.3	--	--	4.3	--	2
Tricoptera	--	--	--	--	--	212	94	197	--	208	--	4
Hydropsychidae	--	--	--	--	--	57	71	174	--	208	--	4
Hydropsyche sp.	--	--	--	--	--	57	71	174	--	208	--	4
Leptoceridae	--	--	--	--	--	146	--	2.9	--	--	--	2
Psychomiidae	--	--	--	--	--	--	--	8.6	--	--	--	1
Tinodes sp	--	--	--	--	--	--	--	8.6	--	--	--	1
Rhyacophilidae	--	--	--	--	--	5.7	19	4.3	--	--	--	3
Rhyacophila sp.	--	--	--	--	--	5.7	19	4.3	--	--	--	3
Other Tricoptera	--	--	--	--	--	2.9	4.3	7.1	--	--	--	3
Number of Taxa[1]	8	9	2	5	6	13	15	22	16	13	6	
Total No. Insects/m^2	318	612	4.3	74	89	241	230	747	389	328	103	

1 Includes family or genera depending on extent of identification, "others" given the rating of one taxon even though in some cases more than one taxon was represented under this catagory.

TABLE 2.2.10. Counts of Invertebrates Other Than Insects Found in the Major Streams of Vandenberg Air Force Base, California, September, 1975 (no./m^2).

	San Antonio Station 1	San Antonio Station 2	San Antonio Station 3	Santa Ynez Station 1	Santa Ynez Station 2	Canada Honda Creek Sta. 1	Canada Honda Creek Sta. 2	Canada Honda Creek Sta. 3	Canada del Jolloru Sta2	Canada del Jolloru Sta2	Canada del Norte	No. of Sites
Acari												
Pionidae: *Tiphys sp.*	16	1.4	--	--	--	--	--	--	--	--	--	2
Amphipoda												
Talitridae:*Hyalella azteca*	17	40	--	144	8.6	308	135	516	--	180	266	9
Other	--	4.3	186	--	--	--	--	--	--	--	--	2
Gastropoda												
Physidae:*Physa sp.*	11	634	--	14	301	34	377	507	--	--	--	7
Planoribidae:*Gyralus sp.*	15	7	--	--	--	--	--	--	--	--	--	2
Other	--	--	--	1.4	--	--	--	--	--	--	--	1
Hirudinae												
Glossiphonilidae	--	--	1.4	--	2.9	--	--	--	--	--	--	2
Isopoda												
Exosphaeroma sp.	--	--	158	--	--	--	--	--	--	--	--	1
Other	--	--	42	--	--	--	--	--	--	--	--	1
Mysidacea												
Neomysis awatchensis	--	--	2.9	--	--	--	--	--	--	--	--	1
Nemata	--	--	--	--	8.6	--	--	--	--	--	--	1
Oligocheata												
Tubificidae	--	--	--	710	--	--	--	--	--	--	--	1
Other	--	--	--	--	14	--	--	--	--	10	20	3
Ostrocoda	--	--	--	--	26	--	--	--	--	--	--	1
Turbellaria	--	--	34	--	2.9	20	--	7.2	--	--	--	4
Number of Taxa	4	5	6	4	7	3	2	3	0	2	2	
Total #/m^2 Invertebrates Other than Insects	59	688	424	869	364	362	642	1030	0	190	286	
Total Invertebrates, No. of Taxa	12	14	8	9	13	16	17	25	16	15	8	
Total # Invertebrates/m^2	377	1300	428	943	453	601	872	1777	389	306	389	

TABLE 2.2.11. Relative Numbers[1] of Benthic Invertebrates Found in the Lakes, September, 1974.

	Amphipods[2]	Diptera Larvae[3]	Total
Upper Canyon Lake	NA	NA	
Middle Canyon Lake	19	46	65
Lower Canyon Lake	21	43	64
Punchbowl Lake	198	104	302
Mod III Lake	222	46	268

1. Numbers are per 5 Ekman dredge samples
2. *Hyaella azteca*
3. mostly Chironomidae

NA = not available

TABLE 2.2.12. Zooplankton of the Canyon Lakes, September 1974.

	Number per Liter											
	Cladocera				Copepoda				Rotifera			
	Daphnia pulex	D. scholderi	Ceriodaphnia quadrangula	Totals	Calanoida	Cyclopoida	Nauplii	Totals	Brachionus plicatilis	Keratella ssp.	Totals	Total Planktonic Invertebrates
Upper Canyon Lake	8.0	37.3	34.7	80.0	21.3	--	34.7	56	--	5.4	5.4	141
Middle Canyon Lake	6.4	12.8	--	19.2	210.0	--	35.6	235.6	--	--	0	245
Lower Canyon Lake	16.0	64.0	--	80.0	146.0	10.0	10.0	166	2.0	--	2.0	248

TABLE 2.2.13. List of Aquatic Invertebrates Observed or Collected at Various Sites of Vandenberg Air Force Base, September, 1974 to March, 1975.

	Location
INSECTA	
Order Coleoptera[1]	7,8,9,17,27
Family Dytiscidae	1,2,3,9,10
Agabus sp	1,3
Bidessus sp.	3
Derocanthes sp.	2
Hydroporus sp.	9
Ilybius sp.	9
Laccophilus sp.	9
Oreodytes	3
Family Haliplidae	1,3
Peltodytes sp.	1,3
Family Hydrophilidae	3,5,9,10,11
Berosus sp.	3,9
Tropisternus sp.	3,9
Family Psephenidae	10
Order Diptera	1,6,17,20,27,30
Family Chironomidae	3,4,5,7,8,9,10,11,12,14,15
Chironomus sp.	5,7,8,11,12,14,15
Pentatura sp.	3,4
Procladius sp.	14,15
Metriocnemos sp.	3,4,5,7,8,10
Family Culicidae	4,5,10,14,17,19
Charoborus sp.	14,17,19
Family Dixidae	2
Paradixa sp.	2
Family Dolichopodidae	2
Family Empididae	2
Roederiodes sp.	2
Family Heleidae	4
Family Muscidae	3
Limnophora sp.	3
Family Simullidae	3
Family Stratiomyidae	9
Stratiomys sp.	9
Family Tipulidae	3,10
Hexatoma sp.	3
Dicranota sp.	3,10
Order Ephemeroptera	16,17,20,27
Family Baetidae	1,2,3,4,5,7,8,9,10
Triorythodes fallax	3
Family Siphlonuridae	3

1. Locations listed for orders indicate locations where this order was observed but not identified further. See Table 2.2.14 for location descriptions.

TABLE 2.2.13. cont.

	Location
Order Hemiptera	
Family Belostomatidae	1,3,4,10,11
Family Corixidae	1,2,4,5,7,8,9,16,17,20
Corisella decolor	4,5,7,8
Sigara sp.	1,4,5,8,9
Family Gerridae	2,4,9,27
Gerris sp.	2,4,9
Trepobates becki	2
Family Notonectidae	6,9,17,20
Notonecta sp.	6,9
Family Valiidae	2
Order Odonata	10,11,16,17,20
Family Coenagrionidae	9
Hyponeura sp.	9
Isnura sp.	9
Family Cordulegastidae	1
Cordulegaster dorsalis	1
Family Lbellulidae	9
Pseudoleon sp.	9
Order Plecoptera	
Family Nemouridae	1,2,3,10
Nemoura sp.	1,2,3,10
Order Tricoptera	
Family Hydropsychidae	1,2,3,10
Hydropsyche sp.	1,2,3,10
Family Leptoceridae	1,3
Family Psychomiidae	3
Tinodes sp.	3
Family Rhyacophilidae	1,2,3
Rhyacophila sp.	1,2,3
CRUSTA EANS	
Order Amphipoda	
Family Talitridae	
Hyalella azteca	most locations
Order Isopoda	
Family Sphaeromidae	6
Exosphaeroma sp.	6
Order Decopoda	13
Order Mysidacea	6
Neomysis awatchensis	6
Order Ostracoda	8,13

TABLE 2.2.13. cont.

	Location
Order Cladocera	
Family Daphnidae	12,13,14,17
Daphnia magna	17
D. pulex	12,13,14
D. schodleri	12,13,14
Ceriodaphnia quadrangular	13
Simocephalus vetulus	temporary ponds
Order Copepoda	
Family Calanoida	12,13,14
Family Cyclopoida	12,13
ROTIFERA	
Keratella sp.	13,20
Brachionus plicatilis	12
MOLLUSCA	
Order Gastropoda	
Family Physidae	
Physa sp.	1,2,3,4,5,7,8,16,17,20,27
Family Planoribidae	4,5,16
Gyralus sp.	4,5
OTHER INVERTEBRATES	
Order Acari	24
Family Poionidae	
Tiphys sp.	2,3
Order Oligochaeta	3,7,8,10,11,30
Family Tubificidae	7
Order Turbellaria	1,3,6,8,14
Order Nemata	8
Order Hirudinae	7,13,17
Family Glossiphoniidae	6,8

TABLE 2.2.14. Location of collection sites given in Table 2.2.13.

1. Cañada Honda Creek Station 1
2. Cañada Honda Creek Station 2
3. Cañada Honda Creek Station 3
4. San Antonio Creek Station 1
5. San Antonio Creek Station 2
6. San Antonio Creek Station 3
7. Santa Ynez River Station 1
8. Santa Ynez River Station 2
9. Cañada del Jolloru Station 1
10. Cañada del Jolloru Station 2
11. "Cañada del Norte"
12. Lower Canyon Lake
13. Upper Canyon Lake
14. Middle Canyon Lake
15. Punchbowl Lake
16. Mod III Lake
17. "Joe's" Lake
18. "Lompoc Casmalia" Pond
19. "Triangle" Pond
20. El Rancho Pond
21. San Antonio Lagoon
22. Santa Ynez Lagoon
23. "Umbra" Pond
24. "Tangair" Ponds
25. "Dune" Pond
26. "Barka I" Pond
27. La Salle Canyon
28. Shuman Canyon
29. "El Rancho Oeste" Pond
30. Aqua Viña

The results of the quantitative stream samples indicated the greatest diversity of insect species are to be found in streams of higher current, Cañada Honda Creek and Cañada del Jolloru (see Numbers of Taxa, Table 2.2.9). This higher diversity is derived mostly from three Orders, Coleoptera (beetles), Plecoptera (stone flies) and Tricoptera (caddis flies). Beetles were found in rather high diversity at Cañada Honda Creek Station 3 and Cañada del Jolloru Station 1. The diversity of beetles, and other insects, at Cañada Honda Creek Station 3 is attributed to the unique character of the station, an area of running water combined with high primary productivity in the form of the green alga *Enteromorpha* ssp. The diversity and numbers of beetles found at Cañada Jollou Station 1 is believed to be artificial in that it was caused by the drying of upper reaches of the stream thus concentrating many of the aquatic insects at this station, which in September was the headwaters of the stream.

The highest densities of aquatic insects occurred at Cañada Honda Creek Station 3 and at San Antonio Creek Station 2. The relatively high densities at Cañada Honda Station 3 can be explained on the basis of the relatively high primary productivity at this station. San Antonio Creek Station 2 has a sluggish current and also a high level of primary productivity in the form of filamentous algae, *Potomogeton, Nasturtium* and other plants. Thus the relatively high densities at this site may also be related to primary productivity.

San Antonio Creek Station 3 had a very low population of aquatic insects in September, 1974. One notonectid (backswimmer) and two diptera larvae were the only insects taken in the samples. The reason for the low density of insects at this location is unknown. Aquatic plants were abundant,

especially *Nasturtium officinale*, so primary production was probably not a factor. Gross water quality appeared to be acceptable (see Table 2.2.1). The only gross differences of this site over others was the presence of marine organisms (*Neomysis awatchensis*, *Exosphaeroma* ssp. and a marine amphipod) and the substrate which was mainly sculptured sandstone rather than mud or gravel. These differences do not seem great enough to preclude an abundant aquatic insect fauna. The lack of insects at this station could be the basis for further study.

Some insects were widely distributed while others were rather limited in their distribution. Diptera larvae and Hemiptera were the most widely distributed occurring at all 11 sites sampled. Of the Diptera, *Metriocnemos* was the most widely distributed genus occurring at six sites, often in high numbers such as at Cañada Honda Creek Station 3. This genus appeared to be present at all stations which had a significant amount of macrophytes, except San Antonio Creek Station 3. Of the Hemiptera, two genera of Corixidae (water boatmen), *Corisella* and *Sigara* occurred at seven sites. In sluggish water such as San Antonio Creek and the Santa Ynez River, these insects occurred in high densities. They were also present in high densities at Joe's Lake and El Rancho Pond.

Ephemeroptera was also widely distributed occurring at nine sites, missing only from San Antonio Creek Station 3 and "Cañada de Norte". While both Diptera and Hemiptera were often dominant orders, Ephemeroptera was never encountered at high densities, at its highest density at Cañada Honda Creek Station 3 it only made up 7.7% of the total insect fauna. Diptera and Hemiptera on the other hand together or alone compromised up to 95% of the total insect numbers found at a station.

Plecoptera and Trichoptera were restricted to running water and were found only in Cañada Honda Creek and Cañada del Jolloru. Where they were found, they were often the dominant insects, comprising up to 60% or more of the total insect numbers.

Most of the other insects encountered were rather rare, usually found in only one or two locations and were normally in low densities. Most sampling stations contained one or two dominant species which constituted from 50 to 80% of the total insect fauna. *Sigara* sp. represented 80.5% of the insect fauna at San Antonio Creek Station 1. *Chironomus* sp. represented 54.5% of the insect fauna at San Antonio Creek Station 2. *Chironomus* sp. and *Metriocnemus* sp. represented 51.5% of the insect fauna at Santa Ynez River Station 1. The major exception to this rule was Cañada del Jolloru Station 1 where, though two orders, Diptera and Coleptera accounted for more than 90% of all insects found, the Coleptera, at least, was represented by at least seven genera and none of them were dominant.

The other invertebrates sampled represented fewer taxonomic groups than the insects but accounted for a high proportion of the number of invertebrates found. Fourteen taxonomic groups of other invertebrates were found versus 50 taxonomic groups of insects. Invertebrates other than insects generally accounted for more than 50% of the total number of invertebrates. Two groups were exceedingly common. Amphipoda, mainly *Hyalella azteca* and Gastropoda, represented by *Physa* sp. Other groups which were common at a particular site included a marine amphipod and a marine isopod at San Antonio Creek Station 3 and Oligocheates of the family Tubificidae found at Santa Ynez River Station 1.

The benthic invertebrates of the lakes were comprised of only amphipods (*Hyalella azteca*) and diptera larva (see Table 2.2.11). The numbers found in Middle and Lower Canyon Lakes were less than found in Punchbowl Lake and Mod III Lake. This difference in numbers may reflect the role of fish as predators of these organisms or may be related to habitat differences between the lakes.

The planktonic invertebrates of the Canyon Lakes are presented in Table 2.2.12. Calanoid copepods were the dominant planktonic organism in Middle and Lower Canyon Lakes. The dominant cladoceran was *Daphnia scholderi* though *D. pulex* was present and *Ceriodaphnia quadrangula* (generally an inhabitant of littoral zones) was common in Upper Canyon Lake.

Table 2.2.13 is a list of all invertebrates found and identified during our study of the aquatic systems of the base. The numbers indicate the locations where they were found. The list is incomplete as the invertebrates of some sites were not examined, and for other sites only the common, very abundant, or unusual organisms were examined.

True aquatic vertebrates mainly fall into two catagories, fish and amphibians. These organisms require an aquatic habitat to survive and/or to reproduce. Other vertebrates, while not physiologically required to inhabit aquatic systems, are behaviorally adapted such that they require aquatic habitats to exist in a natural state. These vertebrates include reptiles, such as turtles; mammals, such as beaver, muskrat, and otters; and various birds, such as kingfishers, ducks, and terns. Most of these catagories are well represented among the aquatic vertebrates of Vandenberg AFB.

2.2.4. Vertebrate Structure and Productivity

Table 2.2.15 presents a list of all aquatic vertebrates located on the base. The enumeration and identification of the vertebrates other than the fish is covered in other sections of this report so that only limited data on these other vertebrates will be presented in this section.

The freshwater fish fauna of Vandenberg AFB, as for most of California, consists mainly of introduced species. *Gasterosteus aculeatus*, the threespine stickleback, is the only exception. This species is represented on the base by two subspecies, *G. a. microcephulus*, the partially armoured threespine stickleback and *G. a. williamsoni*, the unarmoured threespine stickleback.

G. a. microcephulus occurs over much of California and Baja California and has been collected previously in the Santa Ynez River (ref. 5) where they were found during our study. *G. a. williamsoni*, which was found in San Antonio Creek and El Rancho Pond, has a much smaller range and is generally limited to the Los Angeles Basin. A population of this subspecies was present in tributaries of the Santa Maria River as late as 1940, but has subsequently been mixed with introduced stocks of *G. a. microcephulus* (ref. 5). The presence of *G. a. williamsoni* in San Antonio Creek has not been previously recorded. The main distinction between stocks of *G. a. microcephulus* and *G. a. williamsoni* is the number of lateral plates. *G. a. microcephulus* generally average 3-7 lateral plates while the average number of plates for *G. a. williamsoni* is less than one with most individuals having zero plates. Integrades between these two types exist and have average plate counts of between 1 and 3 (ref. 5).

The *G. a. microcephulus* found in the Santa Ynez River had lateral plate counts ranging from 3-6, with an average of 4.1. The *G. a. williamsoni* found

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TABLE 2.2.15. Aquatic Vertebrates of Vandenberg Air Force Base.

	Scientific Name	Common Name	Location**
	FISH		
(F)	*Archoplites interruptus**	Sacramento Perch	LCL
(F)	*Cyprinus carpio*	Carp	SA
(M)	*Eucyclogobius newberryi*	Tidewater Goby	SYR,SYL
(F)	*Gambusia affinis*	Mosquito Fish	SYR,SA,ER,LC,CL,MOD III,PB
(F)	*Gasterosteus aculeatus microcephalus*	Partially Armoured Three-spined Stickleback	SYR
(F)	*Gasterosteus aculeatus williamsoni*	Unarmoured Three-spined Stickleback	SA,ER
(F)	*Ictalurus catus**	White Catfish	SA
(F)	*Ictalurus punctatus*	Channel Catfish	CL,MOD III,PB
(F)	*Lepomis macrochirus*	Bluegill Sunfish	MOD III,SYL
(F)	*Lepomis microlophus*	Red-ear Sunfish	PB
(M)	*Leptocottus armatus*	Stag Horn Sculpin	SYL
(F)	*Micropterus salmoides*	Largemouth Bass	CL,MOD III,PB,LC
(F)	*Pimephales promelas*	Fathead Minnow	SYR
(M)	*Platichthys stellatus*	Starry Flounder	SYL
(F)	*Pomoxis nigromaculatus**	Black Crappie	LCL
(F)	*Salmo gairdneri*	Rainbow Trout	MOD III
	AMPHIBIANS		
+	*Hyla regilla*	Pacific Treefrog	most locations
	Rana aurora	Red-legged Frog	ER,SYR
	Rana catesbeiana	Bullfrog	SYR
	REPTILES		
	Clemmys marmorata	Western Pond Turtle	SA,CL
+	*Thamnophis couchi*	Western Aquatic Garter Snake	most locations
	MAMMALS		
	Castor canadensis	Beaver	SA,SYR
	BIRDS		
	Sterna albifrons	Least Tern	SA
	Megaceryle alcyon	Belted Kingfisher	SA
	Butorides virescens	Green Heron	SA
	Nycticorax nycticorax	Black Crowned Night Heron	SYL
	Anas platyrhynchos	Mallard	SA
	Fulica americana	American Coot	SA,CL,PB,MOD III
	Podiceps caspicus	Eared Grebe	JL
	Oxyura jamaicensis	Ruddy Duck	JL
	Ardea herodias	Great Blue Heron	SA
	Anas cyanoptera	Cinnamon Teal	PB
	Rallus limicola	Virginia Rail	SA
	Leucophoyx thula	Snowy Egret	SYL

* Reported as present at one time but not found during the study period

** CL = Canyon Lakes
LCL = Lower Canyon Lake
SA = San Antonio Creek
SYR = Santa Ynez River
SYL = Santa Ynez Lagoon
ER = El Rancho Pond
PB = Punchbowl Lake
MOD III = Mod III Lake
LC = Lompoc Casmalia Pond
JL = Joe's Lake

(F) = freshwater species
(M) = marine species
\+ = semi-aquatic

in San Antonio Creek and El Rancho Pond had lateral plate counts ranging from 0-4 with an average of 0.39. (See Table 2.2.16.)

Only a few individuals of *G.a. williamsoni* were found in El Rancho Pond. These were adults and were found in the fall; in the spring a number of attempts at collection failed to produce further specimens. The sticklebacks and mosquito fish found there were probably planted from San Antonio Creek as a mosquito control measure.

As the unarmoured threespine stickleback is considered rare and endangered, care should be taken to protect its present habitat in San Antonio Creek. A very important consideration is that individuals of the population of *G. a. microcephulus* of the Santa Ynez River not be introduced into the population of *G. a. williamsoni* of San Antonio Creek. Two other considerations warrant mention. Personnel of the Flight Surgeon's Office have been using the population of *G. a. williamsoni* as test organisms to monitor sewage toxicity. This use probably does not, at present, pose a threat to the existing population, but precautions should be taken to ensure that in the future the population is not seriously reduced by collection, and that populations of *G. a. microcephulus* and *G. a. williamsoni* are not mixed. A third potential problem is the undocumented introduction of *G. a. williamsoni* into other waters such as El Rancho Pond.

In this connection precautions also should be instituted to prevent base personnel from disturbing this rare and endangered fish. Fishermen were observed collecting *Gambusia affinis* from the Canyon Lakes to be used as bait for a fishing trip to off-base waters. Similar use of the fish population of San Antonio Creek could cause unintentional and undocumented

TABLE 2.2.16. Counts of Lateral Plates in Selected Populations of Threespine Sticklebacks.

Location	Number of Plates/Side										N	$\bar{X}$
	0	1	2	3	4	5	6	7	8	9		
[1]Santa Ynez River Station 1 (*G.a. microcephulus*, this study)	--	--	--	1	8	8	1	--	--	--	18	4.5
Santa Ynez River near Juncal Dam (*G.a. microcephulus*, ref. 5)	--	--	--	2	1	5	14	9	1	--	32	5.94
Hatchery Near Fillmore (1942) (Intergrade between *G.a. microcephulus* and *G.a. williamsoni*, ref. 5)	24	8	16	6	9	--	--	--	--	--	60	1.57
[1]San Antonio Creek Station 1 (*G.a. williamsoni*, this study)	12	2	4	1	1	--	--	--	--	--	20	0.85
[1]San Antonio Creek Station 2 (*G.a. williamsoni*, this study)	45	5	--	2	--	--	--	--	--	--	52	0.21
Los Angeles River (*G.a. williamsoni*, ref. 5)	58	8	9	1	--	--	--	--	--	--	76	0.38

1 Each side counted separately, number of fish examined equals 1/2 N.

introduction of *G. a. williamsoni* to other systems. This would tend to confuse the distribution pattern of this indigenous fish.

Some thought should also be given to the documented introduction of *G. a. williamsoni* to other streams and ponds. Most of the streams on base would probably not support a population of this fish, as weedy areas are required for breeding, but attempts could be made, especially in Cañada del Norte and Cañada del Jolloru where small amounts of suitable habitat appear to be present. Cañada Honda Creek and Shuman Canyon Creek have little in the way of weedy areas. They will probably not support a breeding population, though stocking might still be attempted. The evidence from El Rancho Pond indicates that these fish may not reproduce in a stagnant water situation. Stocking of ponds with *G. a. williamsoni* would be on an experimental basis. If stocking of *G. a. williamsoni* is to be considered, some thought should be given to stocking only individuals having a zero plate count thus perhaps producing a strain having even fewer lateral plates, similar to those which were found in the Mohave River in 1950 (ref. 5). The recovery team designated by the California Dept. of Fish and Game should be consulted prior to any management activities.

The remainder of the fresh water fish species have been introduced to Vandenberg AFB. The Sacramento perch (*Archoplites interruptus*) was introduced to Lower Canyon Lake after 1965 when the lake was formed. There is evidence that this species, a native of California, did reproduce in Lower Canyon Lake (ref. 6), though it apparently has not done well enough to contribute significantly to the present fish population of this lake. No specimens were taken in net hauls made in this lake during this study.

Black Crappie (*Pomoxies nigromulatus*) was also introduced into Lower Canyon Lake but our study failed to turn up any specimens. Bluegill sunfish (*Lepomis macrochirus*) was a third species introduced to the Canyon Lakes and to Mod III Lake. No evidence of a population of these fish was found in the Canyon Lakes, but Mod III Lake has at least a small population. One dead adult was found in Mod III and a number of young were captured in a dip net sample in September 1974. No bluegill were captured in any seine haul of the Canyon Lakes or of Mod III. One adult specimen was captured in a seine haul of the Santa Ynez Lagoon in March of 1975. This may have been a transient. During the summer months the lagoon is brackish and would not be expected to support a population of these fresh water fish. Another possibility is that this individual represents a viable population of bluegill which have adapted to the fluctuating salinity of the lagoon. Further sampling would be needed to determine the status of this fish in the Santa Ynez Lagoon. Red-eared sunfish (*Lepomis microlophus*) were introduced into Punchbowl Lake in 1973 or 1974, after the lake was treated with rotenone to remove a carp population. Four seine hauls of the lake in March 1975 produced 10 individuals. The largest individual was 93 mm long and weighed about 18 grams. Scale analysis revealed one annulus indicating that this fish was two years old. Most of the other individuals were 30-70 mm long and no annuli were found indicating that these fish were at the end of their first year. These fish often spawn twice a year, in the spring and in the fall, so that the size classes represented in our sample may be various fall and spring hatchings. In general, this red-ear population appears to be in good condition.

Largemouth bass (*Micropterus alaamoides*) have been introduced into the five lakes of Vandenberg AFB and viable populations are still present in

all of them. As this was the major warm water species and made up a major portion of the recreational fishery, it was the most heavily studied. Specimens were obtained from all Canyon Lakes and from Punchbowl Lake. No specimens were collected from Mod III Lake, though catch records indicated their presence. The specimens captured were few (28) and only represent a few age classes so that the conclusions reached below are very tentative. But some trends are indicated which may warrent further study. Table 2.2.17 is a list of all specimens of largemouth bass captured, where they were captured, their length, their weight and their condition factor. The condition factor was calculated as $W/L^3 \times 10^5$, where W = weight in grams and L = fork length in mm. The value 10^5 forces the value to be near one (ref. 7). When the length-weight relationship is given by $W = aL^3$ then a condition factor of 1.5 indicates that an individual fish has the expected weight for its length. If the condition factor is less than 1.5, then the fish is lighter than would be expected, while if it is greater than 1.5 then the fish is heavier.

Regression analysis of log W on log L for all the largemouth bass in our sample yields $W = aL^{2.96}$ which is sufficiently close to $W = aL^3$ to justify the use of the above formula for condition factor. The average value of condition factors for the four lakes from which largemouth bass were captured (Table 2.2.17) fall into two catagories, high condition factors for Middle Canyon Lake and for Upper Canyon Lake and low condition factors for Lower Canyon Lake and Punchbowl Lake. Since only two specimens were taken from Punchbowl Lake, the validity of the condition factor is doubtful. The condition factor for the fish of Lower Canyon Lake indicates that these fish are

TABLE 2.2.17. List of Largemouth Bass Captured March, 1975, VAFB

Lake	Length (mm)	Weight (gm)	Condition Factor
Lower Canyon Lake	82	5	0.907
	84	7	1.181
	92	14	1.798
	100	10	1.000
	103	12	1.098
	108	17	1.350
	157	55	1.421
	188	100	1.505
	190	107	1.560
	200	121	1.512
	200	120	1.500
	208	133	1.478
	210	122	1.317
Middle Canyon Lake	72	10	2.679
	89	20	2.837
	165	60	1.336
	212	190	1.679
Upper Canyon Lake	66	6	1.995
	67	6	1.995
	185	111	1.753
	187	120	1.835
	220	190	1.784
	224	176	1.566
Punchbowl Lake	103	12	1.098
	230	188	1.766

Average Condition Factors for Largemouth Bass

	Mean Condition Factor	(N)
Lower Canyon Lake	1.356	13
Middle Canyon Lake	2.140	4
Upper Canyon Lake	1.821	6
Punchbowl Lake	1.432	2

not as heavy for a given length as are the fish of Upper Canyon Lake or Middle Canyon Lake. It can be seen that much of this lack in weight gain is due to the small fish (Table 2.2.17). Table 2.2.18 presents growth data obtained from analysis of the scales of the largemouth bass captured. Also Table 2.2.18 gives growth data based on scale analysis taken from four other bodies of water in California and elsewhere (ref. 8). These data show that with respect to growth in length of bass, the lakes may be ranked from best to poorest as follows: Punchbowl Lake, Upper Canyon Lake, Middle Canyon Lake and Lower Canyon Lake. The growth rate of largemouth bass in Lower Canyon Lake seems definitely retarded. Comparison of the growth rate of the largemouth bass from these four lakes to other lakes of California indicates that, overall, those of the base have lower growth rate. The growth rate in Lower Canyon Lake approaches that of cold water ponds of Montana and Ohio (see Table 2.2.18).

Quantitative population studies of the largemouth bass were not done but results of the seining indicate that Lower Canyon Lake and Upper Canyon Lake have a larger population of fish than Middle Canyon Lake. The return for approximately equal effort from Lower and Middle Canyon Lakes was 13 and 4 individuals, respectively. On a fish per net haul basis, Lower Canyon Lake produced 3.25, Middle Canyon 1.0 and Upper Canyon 3.0.

What are the reasons for the low growth rates of these lakes, especially Lower Canyon Lake? Punchbowl Lake has only recently been stocked with fish, so that this lake will not be considered in the following discussion; good growth there may only reflect the sprout of growth permitted by previously unexploited food supply. Observation of the Canyon Lakes indicates that Upper

TABLE 2.2.18. Calculated Lengths in mm for Largemouth Bass at Each Annulus. Data for Lakes Other than Those Located on Vandenberg AFB taken from Calhoun (ref. 8).

	Type of Measurement	Annulus			
		I	II	III	IV
Lower Canyon Lake, VAFB	FL[2]	66.3 (6)[1]	132 (4)	181 (3)	205 (1)
Middle Canyon Lake, VAFB	FL	64.3 (2)	159 (2)	199 (1)	
Upper Canyon Lake, VAFB	FL	65.0 (2)	198 (1)		
Punchbowl Lake, VAFB	FL	85.5 (2)	220 (1)		
Sutherland Reservoir, Calif.	FL	165	290	363	414 (ref. 8)
Folsom Lake, Calif.	FL	143	265	326	368 (ref. 8)
Millerton Lake, Calif.	FL	105	199	286	348 (ref. 8)
Montana Ponds	TL[3]	48	97	145	196 (ref. 8)
Ohio (slow growth)	TL	58	132	203	254 (ref. 8)

1 Number in parentheses indicates number of individuals examined.

2 Forklength

3 Total length

Canyon Lake is very different from the other two. This lake is small, and normally has a heavy weed cover in the form of reeds (*Typha* and *Scirpus* spp.), pond weed (*Potomegeton* spp.) and filamentous algae. In general it can be considered marshy. The other two lakes are similar to each other, both have shallows in their northern portions which contain many dead trees and some aquatic macrophytes. Their central and eastern portions (near the dams) are essentially plant free. Our seining operations, with the exception of one channel catfish, captured only largemouth bass from the Canyon Lakes. This indicates a general lack of forage fish for the bass populations. Visible observations and qualitative dip netting along the shore also indicated a lack of forage fish. The mosquito fish (*Gambusia affinis*) are present in the lakes, but these fish inhabit very shallow waters along the shore and are generally inaccessible to the bass, at least to the larger individuals.

Stomach analysis of two fish from each of the Canyon Lakes indicates that the diet of the fish of Upper Canyon Lake is quite different than those of Middle and Lower Canyon Lakes (Table 2.2.19). The fish of Upper Canyon Lake were feeding almost exclusively on dragonfly nymphs, which comprised 97% of total bulk of stomach contents. The fish of Middle and Lower Canyon Lakes were feeding on much smaller organisms such as small crustaceans and diptera pupae. Normally largemouth bass switch from a small crustacean or insect diet to a fish diet at a size range of 50-75 mm in length and individuals of 150 mm or more generally have a diet consisting mainly of fish (ref. 8). All of the above information indicates that the largemouth bass of the Canyon Lakes have a poor food supply. Upper Canyon Lake because of its weedy nature has an abundant source of insects to act as an alternate food source. Crayfish were found in this lake, though the population is probably very low, and these can

TABLE 2.2.19. Stomach Analysis of Largemouth Bass

	Lower Canyon Lake (2 Fish 185 & 210 mm)		Middle Canyon Lake (2 Fish 165 & 212 mm)		Upper Canyon Lake (2 Fish 185 & 220 mm)	
	% of No.	% of Bulk	% of No.	% of Bulk	% of No.	% of Bulk
Cladocera	88.2	77.8	81.9	67.0	0.0	0.0
Diptera pupae	11.3	20.1	12.3	18.5	0.0	0.0
Diptera larvae	0.4	1.6	1.8	2.4	0.0	0.0
Amphipod	0.1	0.1	3.4	9.7	22.0	0.3
Ephemeroptera	0.0	0.0	0.0	0.0	5.5	0.07
Odonata	0.0	0.0	0.8	2.3	61.0	97.0
Leech	0.0	0.0	0.0	0.0	11.1	2.6

Relative Volume of Prey Items

Cladocera = 1

Diptera pupae = 2

Diptera larvae = 0.5, 3 or 4 depending on size

Ephemeroptera = 4

Odonata = 4 or 500 depending on size

Leech = 75

contribute to a largemouth bass diet. The presence of this invertebrate food source, and food organisms which are carried into the lake by its input stream has apparently enabled the bass population of this lake to maintain a respectable growth rate despite the lack of forage fish. Aquatic invertebrates, especially large ones such as odonata nymphs, leeches, crayfish, are apparently in very low numbers in Middle and Lower Canyon Lakes. Thus the bass must rely on a diet of small insects and crustaceans as indicated in Table 2.2.19. Since larger bass, greater than 150 mm, feed extensively on this food source, they will compete with the smaller bass, less than 50 mm, which normally rely on these organisms for their main food source (ref. 8). Thus competition for food in Middle and Lower Canyon Lakes may be the limiting factor in the growth rate of the fish. The use of herbicides in Middle and Lower Canyon Lakes may be the main reason for the poor food supply in these lakes. Complete removal of aquatic plants produces two effects, reduction in primary productivity with a corresponding reduction in secondary productivity, in this case invertebrates and fish. It also reduces or eliminates refuges of smaller fish and invertebrates making them subject to more intense predation. In an extreme case this could lead to virtual extinction of some of the prey species. This may be the case for Middle and Lower Canyon Lakes, particularly crayfish and forage fish.

A possible solution to the poor growth rate of bass in these lakes lies in the introduction of forage fish. A number of possibilities exist: 1) restocking with bluegill or other sunfish, 2) stocking with threadfin shad, a fish commonly used as a forage fish for largemouth bass, 3) stocking with fathead minnows from the Santa Ynez River, and 4) any combination of the above.

Other possibilities exist and which one would provide the best answer can only be answered after a more thorough examination of the systems involved and ultimately in a field trial. In any case, stocking with a forage fish must be done after a better policy of weed control is adopted. It is obvious from nutrient analysis of the lakes and of the extensive weed growth in Upper Canyon Lake and Punchbowl Lake that some sort of weed control program is necessary. The exact form of this program depends on a number of factors such as available technology, equipment, personnel and finances. But the main emphasis should be on a program which leaves some weed beds.

Channel catfish (*Ictalurus punctatus*) have also been introduced to all of the lakes of Vandenberg AFB. Two individuals were captured in our seine hauls of the lakes. One in Punchbowl Lake and a second from Lower Canyon Lake. These fish had lengths of 340 mm and 273 mm, respectively. Channel catfish are periodically stocked into the lakes. These fish, unlike the largemouth bass, probably do not have a self-sustaining population. Reproductive success of channel catfish in stocked lakes is often poor (ref. 8). Thus a successful channel catfish fishery often requires periodic stocking. Channel catfish fingerlings are apparently very susceptible to predation, especially by largemouth bass, thus successful stocking requires larger fish, about 250 mm (ref. 8). Because of the apparent food shortage in the Canyon Lakes, channel catfish, because of competition with largemouth bass for the existing food sources, may have lower growth rates than in Punchbowl or Mod III Lakes.

Rainbow trout (*Salmo gairdnerii*) are stocked each winter into Mod III Lake. These fish apparently produce the most popular freshwater fishery on

the base. A sort of creel census is taken of this fishery. This consists of a log book at the entrance to the lake in which the fishermen voluntarily note the number of hours fished and the number of fish caught. These data are used to determine the success of the fishery. Table 2.2.20 presents some of these data.

This stocking program probably has some effect on the other fish of the lake. Two possible effects are: 1) increased crowding and competition for food especially among the trout, bluegill and first year largemouth bass, and 2) acting as a food source for the larger bass. The trout are normally added to the lake in five portions a number of weeks apart thus crowding and food competition are probably kept to a minimum. Thus the main effect to the other fishery is probably in providing food for the large bass. It is reported by personnel of the base that Mod III Lake produces the largest bass, up to 8 pounds, of any of the lakes.

Though at present the stocking of rainbow trout is restricted to Mod III Lake, there is no reason to believe that stocking of this fish in the other lakes would be less successful, especially in Middle and Lower Canyon Lakes. Cañada Honda Creek has the potential of supporting a breeding population of rainbow trout but because of its small size and poor accessibility it could not be expected to support a sizable fishery.

In the past the Santa Ynez River supported a substantial steelhead trout run. The use of the river by these ocean-going fish apparently ceased with the construction of Cachuma Dam in the mid-1950's. There is some hope that with some modifications and proper management that these fish could once again use the Santa Ynez River for spawning.

TABLE 2.2.20. Stocking and Catch Data of Rainbow Trout in Mod III Lake.

Year	1971-72	1972-73	1973-74
Number planted	7,075	7,435	8,880
Pounds planted	2,150	1,750	1,670
Number/pound	3.3	3.8-5.1	5.0-6.0
Number caught	5,799	6,598	--
Percent return	82	88	--
Angler hours	6,162	5,208	--
Catch/angler hour	0.94	1.24	--

The marine fishes captured and identified during our study all occurred in the Santa Ynez River and/or the Santa Ynez Lagoon. The list of these fishes as presented in Table 2.2.15 is probably very incomplete as only a limited sample was taken from the lagoon. *Eucyclogobius newberryi*, the tidewater goby, was taken with dip nets at Station 2 in the Santa Ynez River (located under the 13th Street bridge) and also in seine hauls of the lagoon. Two seine hauls of the lagoon taken in March 1975 at low tide produced numerous individuals of starry flounder (*Platyichtyys stellatus*) and staghorn sculpins (*Leptocottus armatus*). As many as 30 of each species were taken in a single haul. The lagoon apparently acts as a nursery ground for the starry flounder. This fish has its southern distributional limit near Santa Barbara. Since the Santa Ynez Lagoon is the first major lagoon north of Santa Barbara, this lagoon may be the most southern of the nursery grounds of this fish.

Other fishes are often associated with *Platichthys stellatus* and *Leptocottus armatus* (ref. 9). Those which are known to occur in the Vandenberg area include *Atherinops affinis* (top smelt), *Cymatogaster aggregata* (shiner perch) and *Syngnathus griseolineatus* (bay pipe fish) (ref. 10).

The major mammal associated with the aquatic systems of Vandenberg AFB is the beaver (*Castor canadensis*). This animal has been introduced by the California Department of Fish and Game. It has become well established in the San Antonio Creek drainage and is also present in the Santa Ynez River. An attempt to establish beaver in Cañada Honda Creek has apparently failed. No sign of beaver were observed in this stream.

Beaver are common in the San Antonio Creek drainage. Three active dams were located on the stream between 13th Street and just north of highway S-20.

Others may be present in the area of Barker Slough and the riparian areas west of Mod III Lake. Three beaver dams were found on small tributaries to the San Antonio Creek. Two of these create what we have called "Triangle Pond". This pond is located in a northern drainage to San Antonio Creek. "Lompoc-Casmalia Pond", a southern drainage of San Antonio Creek, was formed by the third dam. Both of these ponds have more than an acre of surface area (see Table 2.1.1).

Beaver ponds often create suitable habitat for other aquatic vertebrates and invertebrates. "Lompoc-Casmalia Pond" appears to be the oldest of these two and has an extensive aquatic animal population. These animals include fish (mosquito fish and largemouth bass), numerous frogs, western pond turtles and many aquatic insects and other invertebrates.

Although no quantitative data were gathered during our study as to the size of the beaver population, some estimates can be made based on the natural history of these animals. Shelton (ref. 11) states that colony size of the beaver of Isle Royale varied between about 6-10 individuals. He also noted that a beaver colony would often use two ponds and that different colonies were generally well separated. On this basis, the two ponds at Triangle Pond can be assumed to be used by a single colony. Two of the dams found on the San Antonio Creek were in close proximity to each other, so that they probably represent only a single colony. Thus at least five colonies are known to be present on the base, two on San Antonio Creek, one each in Triangle Pond, "Lompoc-Casmalia Pond" and the Santa Ynez River. Assuming an average of eight individuals/colony, this would yield 8 x 5 or 40 individuals. This is probably an underestimate as more than 5 colonies are believed to be present on the base. A rough estimate then, based on present data would indicate a beaver population of from about 40 to 100 individuals occurs on Vandenberg AFB.

3. - VEGETATION ANALYSES

3.1. Methods

3.1.1. Introduction. Vegetation is best characterized by two fundamental features: 1) species composition, and 2) physiognomy. The first is important because species are the fundamental and relatively unchanging units of ecology. If the species present in an area are known, an ecologist familiar with the region is able to surmise a great deal about the ecological relationships existing within the area. Physiognomy, which we take here very broadly to include information on the size, number, and distribution of species is significant because it reflects the favorableness of the environment, the relative importance of life-forms, and many other features important to a complete understanding of the plant and animal ecology.

Both of these fundamental aspects have received attention in the design of our vegetational analysis.

3.1.2. Key to Vegetation Types. The first step in the vegetational analysis was the preparation of a vegetational key to plant communities found on the base. This key went through two major revisions. The final version is presented in Table 3.1.1. The categories in the key are the significant vegetational types which exist on the base. All of the vegetation and vertebrate community analysis is summarized in accordance with these vegetation types. These units were selected and named to agree as much as possible with existing California vegetation classification systems. However, since no single scheme seemed to provide the degree of specificity required for this study, the agreement is only approximate. A table showing the equivalents

TABLE 3.1.1. Key to Vegetation Types

The following definitions will be used:

Tree - a woody perennial commonly exceeding 4 m in height or 10 cm dbh or both when mature on the site being evaluated. In young stands this definition may involve some guesswork.

Shrub - a woody perennial less than 4 m tall, and less than 10 cm dbh.

Grass - plants belonging to the family Gramineae, and therefore excluding sedges and rushes.

Percent cover - the percent of the surface of the ground covered by the vertical projections of the plant crowns.

Evergreen sclerophyllous - refers to plants with thick leathery evergreen leaves.

A. Communities dominated by species which have not been planted by man. The species may or may not be native to the region.

B. Tree cover greater than 50%

C. Tree cover less than 50% evergreen

D. Trees conifers

1. Bishop Pine Forest

DD. Trees broadleaf

E. Tree cover more than 50% Tanbark Oak (*Lithocarpus*)

3. Tanbark Oak Forest

EE. Tree cover less than 50% Tanbark Oak, remainder oaks (*Quercus* spp.)

4. Foothill Woodland-Dense Phase

CC. Tree cover less than 50% evergreen (i.e. greater than 50% deciduous), located adjacent to streams, willows and cottonwoods, present and usually dominant

7. Riparian Woodland

BB. Tree cover less than 50%

C. Trees present (i.e. cover of trees greater than 5%)

D. Tree cover greater than 50% Bishop Pine, understory large or small shrubs

2. Bishop Pine Forest-Sparse Phase

DD. Tree cover greater than 50% broadleaf

E. Tree cover greater than 50% evergreen

5. Foothill Woodland

EE. Tree cover greater than 50% deciduous, usually along streams, some in wet places in dunes

7. Riparian Woodland-Sparse Phase

TABLE 3.1.1. cont.

CC. Trees absent or tree cover less than 5%

D. At least 50% of plant cover woody perennial shrubs with less than 10% of the cover of *Mesembryanthemum* (Ice Plant), *Ambrosia chamissonis*, *Abronia* spp, *Convolvulus*; soil not subject to tidal innundation at any time

E. Plant cover greater than 75%

F. At least 50% of the plant cover evergreen sclerophyllous shrubs (e.g. *Adenostoma*, *Rhus*, *Arctostaphylos*, *Ceanothus*, etc.)

G. *Vaccinium ovatum*, *Gaultheria* less than 25% of plant cover

8. Chaparral

GG. *Vaccinium ovatum*, *Gaultheria* greater than 25% of plant cover

15. Huckleberry Scrub

FF. Less than 50% of the plant cover evergreen sclerophyllous shrubs (that is, cover predominantly of species such as *Haplopappus ericoides*, *Salvia leucophylla*, *Encelia californica*, *Artemisia californica*, *Eriogonum parvifolia*, *Baccharis pilularis*)

G. In well-drained soils of uplands, slopes, and sand dunes. Soil near the surface rarely or never saturated or flooded. Water table well below the surface for most of the year. Mostly low vegetation less than 1.5 meters high.

H. Growing on sand dunes

13. Coastal Sage Scrub-Dune Phase

HH. Growing on other substrates

I. Plant cover more than 50% *Salvia leucophylla*

12. Coastal Sage Scrub-*Salvia leucophylla* Phase

II. Plant cover less than 50% *Salvia leucophylla*

10. Coastal Sage Scrub

GG. In poorly drained soils mostly along streams or springs, occasionally small pockets on hillsides at points where fresh ground water is near the surface, small willows (*Salix* spp.) present

14. Wet Soil Scrub

TABLE 3.1.1. cont.

EE. Plant cover less than 75%

F. Substrate beach or dune sand, or partially consolidated sandstones along the coast

G. Plants very low, less than 0.5 m high, mostly really sub-shrubs or some vines. Sand subject to wind movement, cover of plants less than 50%, many species succulent

17. Coastal Strand

GG. Plants taller, greater than 0.5 m high, plant cover usually greater than 50% few vine-like plants, few species with truly succulent leaves, sand relatively stable. Along the coast, largely on partially consolidated material.

13. Coastal Sage Scrub-Stabilized Dune Phase

FF. Other substrates

G. Cliffs and bluffs in the immediate vicinity of the coast. Subject to salt-spray, plants mostly less than 0.5 m high, some succulent-leaved.

16. Coastal Bluff Vegetation

GG. Areas not on sea-facing bluffs above the coast, or not on bluffs and cliffs undergoing rapid erosion, salt-spray less intense or minimal, many plants (when mature) greater than 0.5 m high

H. Shrub cover greater than 50% evergreen sclerophyllous

9. Chaparral-Sparse Phase

HH. Shrub cover less than 50% evergreen sclerophyllous

I. *Salvia leucophylla* greater than 50% of shrub cover

12. Coastal Sage Scrub-*Salvia leucophylla* Phase

II. *Salvia leucophylla* less than 50% of shrub cover

10. Coastal Sage Scrub-Normal Phase

TABLE 3.1.1 cont.

DD. Less than 50% of the plant cover woody perennial shrubs, or if more than 50% shrubs, then salt-marsh subject to tidal innundation

E. Areas frequently flooded by tides, substrate poorly drained and saline, dominated by *Salicornia* spp., *Jaumia*, *Frankenia*, etc.

18. Coastal Salt Marsh

EE. Areas rarely or never flooded by tides, substrate not markedly saline, *Salicornia* spp. absent

F. Poorly drained areas with standing water present for at least a few days a year, vegetation generally actively growing during the summer months, soil saturated within the rooting depth of plants for most of the year

G. Plant cover greater than 75% perennial grass

20. Grassland-Perennial

GG. Plant cover less than 75% perennial grass

19. Freshwater Marsh

FF. Well-drained areas, not in any sense marshy areas

G. Substrate beach sand subject to movement by wind. Immediate vicinity of the ocean. Low vegetation mostly less than 0.5 m high.

17. Coastal Strand

GG. Substrate not beach sand subject to movement by wind. Few or no succulent plants present except for some cacti.

H. Cover of woody shrubs greater than 10%, remaining cover predominantly annual grasses and herbs.

11. Coastal Sage Scrub-Sparse Phase

HH. Cover of woody shrubs less than 10%

I. Plant cover more than 50% grasses

J. Grass cover more than 50% annuals

21. Grassland-Annual

JJ. Grass cover less than 50% annuals

20. Grassland-Perennial

TABLE 3.1.1. cont.

II. Plant cover less than 50% grasses

J. Non-grass cover greater than 50% native species

22. Miscellaneous Native Herb Communities

JJ. Non-grass cover less than 50% native species

23. Ruderal Vegetation

AA. Communities dominated by species planted by man. The planted species usually, but not necessarily, non-native.

B. Tree cover greater than 50%

24. Planted Trees (indicate major species)

BB. Tree cover less than 50%

C. Occurring on land currently under cultivation

25. Agriculture Plantings

CC. Land not currently cultivated, though possibly maintained in other ways, such as by mowing or spraying

26. Non-agricultural Plantings

of our vegetational units with those of two of the better known classifications is provided in Table 3.1.2 to facilitate locating literature relevant to particular types and aid in communication about them.

The key has at least two functions. First, it provides a summary of the criteria used to designate community types, and second, it allows field personnel to classify the vegetation on particular sites.

The emphasis in the key is on physiognomic differences, especially cover and height. This allows types to be largely, though not entirely, specified without knowing the species present. This is an advantage to untrained observers and in the interpretation of aerial photographs, since species usually are difficult to identify on air photos while cover and height can be determined relatively easily.

3.1.3. Determination of Plant Species on the Base. The first phase of field work involved determination of the species present on the base. This was done by collecting specimens of as many plants as possible and determining their scientific names through the use of published manuals, herbaria, and the advice of botanists experienced in the region. The goal of this portion of the analysis was to produce as complete a list of species present on the base as possible. This list is incomplete, but probably includes at least 60% of all vascular plant species found in natural areas on the base, and perhaps 95% of the common forms.

3.1.4. Quantitative Sampling of the Vegetation. Quantitative samples were taken for three purposes: 1) to determine the abundance, importance, and species diversity of species on the base, 2) to characterize the vegetation at the permanent sampling stations so that vegetation-animal relations could

TABLE 3.1.2. Communities Recognized with their Nearest Equivalent in Schemes of Munz and Keck (ref. 12) and Cheathem (ref. 13).

This Key	Munz and Keck	Cheatham
I. Forest, Woodland, Savanna		
1. Bishop Pine Forest	Closed Cone Pine Forest	Coastal Pine/ Cypress Woodland
2. Bishop Pine Forest-Sparse Phase	Closed Cone Pine Forest	Coastal Pine/ Cypress Woodland
3. Tanbark-Oak Forest	Mixed Evergreen Forest?	Mixed Evergreen Forest
4. Foothill Woodland-Dense Phase	Foothill Woodland	Coast Live Oak Forest?
5. Foothill Woodland	Foothill Woodland	Southern Oak Woodland
6. Riaprian Woodland-Sparse Phase	None--considered a component of other units	Lowland Riparian Forest?
7. Riparian Woodland	None--considered a component of other units	Lowland Riparian Forest?
II. Scrub and Chaparral		
8. Chaparral	Chaparral possibly also some Coastal Sage Scrub	Mixed Chaparral
9. Chaparral-Sparse Phase	Chaparral possibly also some Coastal Sage Scrub	Mixed Chaparral
10. Coastal Sage Scrub	Coastal Sage Scrub or Northern Coastal Scrub	Northern California Coastal Scrub
11. Coastal Sage Scrub-Sparse Phase	Coastal Sage Scrub or Northern Coastal Scrub	Northern California Coastal Scrub
12. Coastal Sage Scrub-*Salvia leucophylla* phase	Coastal Sage Scrub	Coastal Sage
13. Coastal Sage Scrub-Dune Phase	Coastal Sage Scrub	Coastal Sage
14. Wet Soil Scrub	None	None
15. Huckleberry Scrub	None	None
III. Coastal Types		
16. Coastal Bluff Vegetation	None or Coastal Sage Scrub	Northern and Central California Bluff Tops
17. Coastal Strand	Coastal Strand	Coastal Dunes--Southern California
18. Coastal Salt Marsh	Coastal Salt Marsh	Coastal Salt Marsh
IV. Grasslands, Marshes, Ruderal		
19. Freshwater Marsh	Freshwater Marsh	Freshwater Marsh
20. Grassland-Perennial	Valley Grassland, if wet, Freshwater Marsh	Valley Grassland--Remnants of California Native Grasses
21. Grassland-Annual	Valley Grassland	Valley Grassland--Introduced Grasses

TABLE 3.1.2. cont.

IV. Grasslands, Marshes, Ruderal cont.			
22.	Miscellaneous Native Herb Communities	None	None
23.	Ruderal Vegetation	None	None
V. Cultivated Vegetation			
24.	Planted Trees	Neither of the schemes considers non-spontaneous vegetation.	
25.	Agricultural Plantings		
26.	Non-agricultural Plantings		

be explored, and 3) to "ground-truth" the vegetation map and aerial photo analysis. Two different types of quantitative samples were taken, "presence and estimated cover plots", and "presence and measured cover samples". The former were done throughout the base, the latter only at the permanent sampling stations.

3.1.4.1. Presence and estimated cover plots. The first 48 presence-cover plots of this type were placed haphazardly in the initial field work in conjunction with plant and animal collecting activities, installation of pitfall traps and other preliminary aspects of the field work. The second group of 55 plots were placed randomly by selecting random air photos and a random point on the air photo and walking to that point. These were collected to provide a random sample of plots for ground truth determinations. Both sets were ultimately used for both ground truth and community characteristics.

The methods used are detailed in Table 3.1.3, which reproduces the field instructions given to field crews. The results of this sampling are summarized by vegetation type in Section 3.1.

3.1.4.2. Presence and measured cover samples. This sampling combined the presence plots described in the previous section with line transect sampling. The purpose was to characterize the vegetation at the permanent sampling stations, and therefore this method of sampling was done only on the 34 permanent sampling stations. (For locations see Appendix A.) The methods used are explained in Table 3.1.4, which reproduces the instructions issued to the field crews.

TABLE 3.1.3. Instructions for Presence and Estimated Cover Plots

1. Plot sizes - Plot design is two concentric circular plots. The larger for trees and shrubs, is 3.99 m radius, the smaller for herbs, 1.26 m. An herb is a plant without perennial woody tissue.
2. Locating plots - This will be done in various ways, but in all cases, the final sampling point should be chosen by a random unbiased method (e.g. random paces forward and to right and left).
3. Data to be collected
   a) Record on <u>every</u> data sheet:

      Your name(s)

      The date

      Location - a descriptive name to aid location

      Data sheet number - a sequential number

      Coordinates - according to Vandenberg AFB system

      Elevation - in feet

   b) If possible also record:

      Slope - express in degrees. This should be the slope on the steepest line through the center of the plot, determined between the edge of the large plot and the center.

      Exposure - express in degrees from north. This is the downslope azimuth of the line along which slope is measured. Thus, you record the exposure of slope facing due north as 0°, due east 90°, due south 180°, etc.

   c) Species data - Data on woody plants and herbs is recorded seperately, on the appropriate places on the data sheet. Except that the woody data is

TABLE 3.1.3. cont.

1c) cont.

taken from the larger plot and herb data from the smaller, procedures are the same. Record:

1) Species present - a species is present if any living portion of that species lies within the imaginary cylinder formed by the vertical projection of the circular plot. To record presence write out the latin name of the species. If the plant is unknown to you, assign a code (e.g. Unknown #1) and collect enough of the plant to identify.
2) Species cover - this is done by visual estimate, placing the species in the cover classes indicated on the data sheet. The estimate is for the vertical projection of the collective crown of the species being evaluated and ignores overlap. Thus a single species may not have more than 100% cover. However, two or more species may have overlap, and this is considered, so that greater than 100% cover is possible when the cover of the separate species sum to more than 100%.
3) Record the above data separately for trees and shrubs.
4) Estimated total plant cover - record here the percent of the plot covered by the vertical projection of plant crowns--ignoring overlap--i.e. 100% will be the maximum possible.
5) Estimated total tree cover - as above, but trees only. A tree is a woody plant more than 4 m high or more than 10 cm in diameter at breast height.
6) Estimated total shrub cover - as above, but for shrubs only.

TABLE 3.1.3. cont.

VEGETATION SURVEY- VANDENBERG AFB

LOCATION ______________________ DATA BY ______________________

STAND No.	DATA SHEET	DATE			COORDINATE			SLOPE	EXPOS	ELEV.	HT	PLOT SIZE T+S	PLOT SIZE H	
		DAY	MO	YR	LAT.	NO.	S							

COMMENTS ______________________

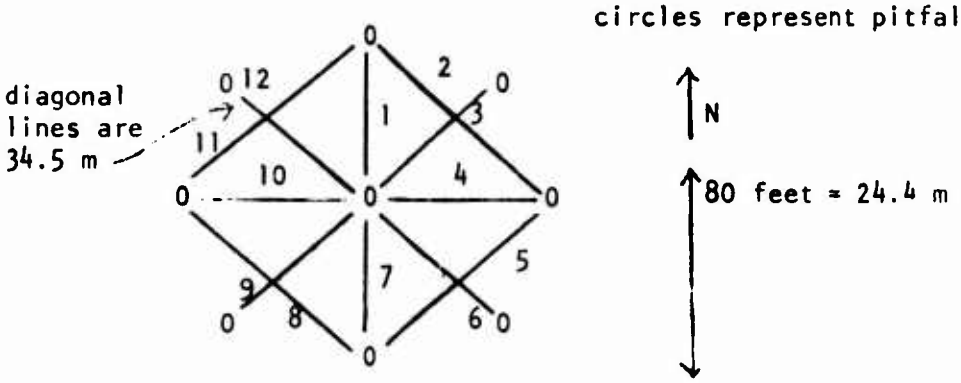
ESTIMATED COVER %

TREES AND SHRUBS	<1	1-5	5-25	25-50	50-75	>75

HERBS						
ESTIMATED TOTAL PLANT COVER-LAYERS						
" " TREE COVER " "						
" " SHRUB COVER " "						

TABLE 3.1.4. Instructions for Presence and Measured Cover Sampling for Permanent Quadrats.

1. Overall objective - to obtain a quantitative description of the vegetation at the trap sites. Data will consist of:
   a) 9 presence-absence estimated cover plots for trees, shrubs, and herbs each of 50 square meter area (i.e., 3.99 m radius).
   b) 2 twenty meter line transects for plant cover along lines selected as explained below.
2. Presence-absence plots - see "Instructions for Presence-Cover Sampling". Place one such plot at each trap centered on the trap. Follow the general instructions but omit measures of slope and exposure. Be absolutely sure to mark the trap number clearly and conspicuously on the data sheet
3. Line transect sampling methods:
   a) Location of transects - two transects will be selected to be taken along two different lines from among the 12 possible inside lines connecting the 9 traps. Starting the numbering from the non-diagonal line pointing most nearly true north, these may be represented as follows.



Two lines are randomly selected using a random numbers table. The same line is not sampled twice, and two lines in the same quadrant which intersect may not be both sampled, (i.e. <u>not</u> both 2 and 3, 5 and 6, etc.).

TABLE 3.1.4. cont.

Non-intersecting lines which meet with an angle less than or equal to ninety degrees may not both be sampled, (e.g. not both 1 and 2, or 1 and 4, or 1 and 3, or 1 and 12, or 1 and 10, etc.). Reject any line which falls along an obviously badly disturbed path--that is, avoid falling along trampled areas.

The transect lines fall along imaginary straight lines connecting the centers of the two traps. The transects will begin exactly two meters from the center of the trap and run out 20 meters. For the eight lines radiating from the center trap, the transect should begin 2 m from the center trap and run out 20 m. For the four other lines, begin two meters from the trap with the lowest number, as shown on C. Mahrdt's map of the plot (Appendix A). In all cases, but certainly for exceptions, also state on the data sheet where the transect begins. This is to facilitate relocation. Adjust this scheme as necessary for other trap configurations.

b) Data and data recording - refer to the following data sheet. Fill in all relevant information. When in doubt, write it down. Data are to be recorded in five meter blocks. For all species, write down a species name and then the lengths of line, in centimeters to the nearest centimeter, which lie above or below a vertical projection of the foliage of the plant. This length of line may include some empty space so long as this is representative and normal of a typical crown of the species. For a single species, the length of a given intercept may include any number of contiguous or overlapping individuals. Lengths of line which lie above bare ground are recorded separately so that total plant cover may be calculated.

TABLE 3.1.4. cont.

If two species overlap or lie in different strata (e.g. shrubs under trees) they are recorded separately. This means where there are two or more species there may be more than 100% cover. If there is only one species recorded, cover cannot exceed 100% no matter how many individuals are present.

The smallest recordable intercept is one centimeter. All shrubs and trees must be identified to species (not necessarily in the field). Herbs should be treated the same as woody plants if this can be done without undue effort. In cases where there is a wide variety of non-flowering herbaceous material, adopt the next most reasonable breakdown--e.g. grasses and forbs.

In the lab, verify the identification and spelling of all species. If there are insoluble problems clearly explain at "Comments", or on the back of the data form.

c) Recording the transect location - on a copy of the plot map to be provided, record the location of the transects by labelled lines. Include appropriate comments. These maps will be filed with the data sheets.

TABLE 3.1.4. cont.

VAFB Vegetation Survey Data sheet _____ of _____

Location: _____

Plot No.: _____ Data Collected by: _____ Date: _____

Description of Transect Location: _____

_____

Comments: _____

Total Length of Transect: _____

Species	0-5m	5-10m	10-15m	15-20m	Totals

3.1.5. Location and Identification of Significant Plant Taxa. The intent of this portion of the analysis was to locate and identify significant plant xa. Of particular interest were those taxa recognized by the California Native Plant Society as "rare, endangered or both" (ref. 14). These are taxa which because of their limited range or exacting habitat requirements are vulnerable to extinction and therefore worthy of special protection. Since a list of these species is available from the Native Plant Society, the procedure was simply one of determining whether or not these particular species were present on the base. This was done by systematically searching the areas most likely to contain the expected species. The locations of the significant taxa discovered on the base were noted, and specimens were collected for verification. The results of this portion of the study are discussed in detail in Volume I, Section 5.3.

3.1.6. Vegetation Mapping. Vegetation mapping using remote sensing techniques has been accomplished in two ways. Overlays of the December 1966 "C" series Base Master Plan were produced, and these maps have been coded in a manner consistant with the data storage and retrieval system, effectively the basis for computer base maps.

Prior to beginning vegetation mapping, the remote sensing analyst spent more than a month observing and becoming familiar with the vegetation. Several return trips were made to check problem areas.

The overlays were made by placing a semi-transparent sheet of velum over the base map to ascertain the landmarks, roads, and man-made structures marked on the base maps. Using the aerial photographs as a guide, the outlines of the vegetation types were then drawn in.

Considerable effort was made in each case to produce lines representing the same shapes and areas of vegetation observed in the photographs, at the scale of the base maps. Vegetation types, man-made structures and disturbed areas which would be smaller than 1/10 inch in diameter or width when reduced to the map scale, have in most cases been ignored due to the difficulty of drawing such small figures. In general, tnese areas are without significance when compared to the overall vegetational area. Examples of vegetation types which often appear in this manner are coastal bluff, wet soil scrub, and huckleberry scrub.

Several of the vegetation types are also capable of gradually intergrading with other adjacent types. In these cases, a determination of the median of the transition is attempted and drawn as the dividing line. This problem is especially acute in areas where grazing is taking place and there is a gradual replacement of shrubs by grassland. One of the criteria for the vegetation categories mapped was the ability to delimit reasonably the boundaries of the different categories, so in no mapped unit is the problem unmanageable.

With the completion of each sheet, while still referring to the photographs, the vegetation units were coded onto data forms and later transferred to data cards for use in the retrieval system. The coding process was accomplished by placing a grid over the overlays and determining the dominant vegetation type for each square and using that code for the type of the entire square.

Initially all vegetation units were coded to a resolution of 2.55 acres (333 foot grid cells) with the major vegetation units eventually to be

reduced to a resolution of 22.3 acres (1000 foot grid cells) for ease of handling. Using these data, various computer maps have been produced. Reproductions of either the computer maps or the overlay types will be available on request.

3.1.7. Ground Truth Verification of Vegetation Map. The accuracy of the vegetation map produced from the air photographs was checked by comparing field samples at known locations to the corresponding location on the vegetation map. The field samples taken were of two kinds: the first was the 50 square meter presence plot (see Section 3.1.4. for a description of the data taken), and the second the permanent quadrats. Together this gave 130 sample points which could be classified to vegetation type using the key. (See Section 3.1.2 for the key to vegetation types.) Table 3.1.5 reports the results of the comparison. The rows represent the vegetation type of the presence plot or quadrat as determined from the actual field data. The columns represent the vegetation type indicated at that location by the map. A misclassification occurs when the map shows a vegetation type different from the field determination, and this is indicated by numbers in the off-diagonal elements. A correct classification results if the map and the field data agree, and the number of times this occurred is indicated by the numbers along the diagonal.

Study of this error matrix reveals that only eight of the 130 field plots or quadrats were not correctly identified on the map. The greatest difficulty was experienced with coastal sage scrub-normal phase, where four out of 30 plots or quadrats in this vegetation type were mapped as other vegetation types. However, three of the mismatches are in the same type of

TABLE 3.1.5. Matrix for Mapping Accuracy

Vegetation Type as Determined in the Field	Vegetation Type as Mapped													
	1BPF	2TOF	3FW	4RW	5C	6CSSN	7CSSS	8CSSD	9WSS	12CS	13CSM	14FM	16GA	Total
1. Bishop Pine Forest	11													11
2. Tanbark Oak Forest		6												6
3 Foothill Woodland			10			1								11
4. Riparian Woodland				6					1					7
5 Chaparral					14									14
6. Coastal Sage Scrub-Normal Phase					1	26	1	1					1	30
7. Coastal Sage Scrub- *Salvia leucophylla* Phase							8						1	9
8 Coastal Sage Scrub-Stabilized Dune Phase								13						13
9. Wet Soil Scrub						1			2					3
12. Coastal Strand										5				5
13 Coastal Salt Marsh											4			4
14 Freshwater Marsh												1		1
16. Grassland Annual													16	16
Total	11	6	10	6	15	28	9	14	3	5	4	1	18	130

Total Plots: 130

Total Plots Mapped as a Type Different from the Field Determination: 8

Percent Mismatches. 8/130 = 6.1%

95% Confidence Interval for Proportion Mismatched: 3.5% - 11.4%

vegetation (chaparral, and two other types of coastal sage scrub), and therefore the error is not particularly serious from the practical point of view. Similarly, the error in the riparian woodland row indicates that one plot that was actually this vegetation type was mapped as wet soil scrub. The difference between these types in this case was only in the height of the vegetation, and therefore the error is not serious since the species composition is very similar.

The overall percentage of mismatches is about 6%, and as we have seen most of these errors are not serious, so that the accuracy for any practical purpose is in fact substantially better than this. The 95% confidence interval about the error estimate is 3.5% to 11.4%. This means that with a very high probability (0.95) the true value lies within these limits. Putting this more simply, it is highly unlikely from a statistical point of view that the error rate is greater than 11.5%.

It should be pointed out that the ground truth test was also very exacting in the case of the plots. What was done was to determine the vegetation in a 50 square meter plot. On the map, it was not possible to represent areas that small, and thus at least some of the mismatches arise because of the differing scale of the mapping and the ground truth plots. This fact, combined with the points made above about the nature of the errors, suggests that the 6% figure for mismatches is probably a maximum as far as the management use of the map is concerned.

3.1.8. Aging of Trees and Shrubs. To assist in interpreting the past history of Vandenberg AFB and to provide information on the growth rate and age of the woody plants, stem sections of small shrubs and increment cores

of large shrubs and trees were taken. These were prepared by sanding, and the annual rings counted, providing an estimate of the age of the stem, and therefore in many cases at least a minimal estimate of the period that the vegetation was free of major disturbance.

3.2. Additional Vegetation Data Summaries

3.2.1. Presence and Estimated Cover Plots. The summaries that follow (Tables 3.2.1 through 3.2.14) give the percent occurrence, average estimated cover, and the range in cover for the 15 most common species encountered in the sampling. Percent occurrence is the number of plots in which a species was observed divided by the total plots taken times 100. Average cover is calculated from the estimates of cover taken as explained in Section 3.1.4.1. The range in cover indicates the highest and lowest value observed, excluding zero.

3.2.2. Presence and Measured Cover Samples. The summaries that follow (Tables 3.2.15 through 3.2.24) give the percent occurrence, average percent cover, and standard deviation of cover by vegetation type for the 15 most frequent species observed in each type. Presence was determined by dividing the total number of times a species occurred in the circular plots by the total number of presence plots taken. The presence plots were identified with those used in the sampling summarized in 3.2.1 except that they were centered on the pitfall traps. (See Section 3.1.4.2 for a fuller description.) The total number of such plots taken in a vegetation type (usually nine at each quadrat) is given at the top of the page.

The cover data were obtained as explained in Section 3.1.4.2. The standard deviation and average of cover are determined between quadrats.

TABLE 3.2.1. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type Bishop pine forest and Bishop pine forest - sparse phase

Summarizes 5 Presence Plots

Total Vascular Plant Species 9

Species Diversity (based on occurrence data) 0.4

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Pinus muricata	100	70	50-100
Arctostaphylos viridissima	100	25	10- 60
Quercus wislezenii	60	5	5- 10
Vaccinium ovatum	60	1.5	<1- 5
Adenostoma fasciculatum	40	3	5- 25
Baccharis pilularis	20	3	1- 25
Salvia mellifera	20	3	1- 25
Ceanothus impressus	20	<1	<1- 5
Herbs			
Dryopteris arguta	20	7.5	<1- 50
Total Plant Cover		100	100

TABLE 3.2.2. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type: Tanbark - oak forest

Summarizes: 3 Presence Plots:

Total Vascular Plant Species: 9

Species Diversity (based on occurrence data): 7.0

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Lithocarpus densiflora	100	85	75-100
Vaccinium ovatum	100	55	25- 90
Rubus ursinus	35	5	<1- 25
Toxicodendron diversilobum	35	1	<1- 5
Symphoricarpus mollis	35	<1	<1- 1
Diplacus longiflorus	35	<1	<1- 1
Herbs			
Polystichum munitum	100	15	<1- 50
Dryopteris arguta	35	<1	<1- 1
Heuchera micrantha	35	<1	<1- 1
Total Plant Cover		100	100

TABLE 3.2.3. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type foothill woodland and foothill woodland - dense phase

Summarizes 8 Presence Plots

Total Vascular Plant Species 27

Species Diversity (based on occurrence data) 14.0

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Quercus agrifolia	100	85	25-100
Toxicodendron diversilobum	75	25	<1- 90
Artemisia californica	25	5	<1- 25
Rubus ursinus	25	2	<1- 25
Lotus scoparius	25	<1	<1- 5
Lithocarpus densiflora	10	10	<1- 75
Salvia mellifera	10	10	<1- 65
Symphoricarpus mollis	10	2	<1- 25
Cercocarpus betuloides	10	2	<1- 25
Rhamnus crocea	10	<1	<1- 5
Rhamnus californica	10	<1	<1
Herbs			
Dryopteris arguta	35	5	<1- 50
Pteridium aquilinum	25	10	<1- 50
Bromus rigidus	25	5	<1- 50
Polystichum munitum	10	2	<1- 25
Total Plant Cover		85	75-100

TABLE 3.2.4. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type riparian woodland and riparian woodland - sparse phase

Summarizes 7 Presence Plots

Total Vascular Plant Species 16

Species Diversity (based on occurrence data) 10.5

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Salix spp. (*lasiandra* + *laseolepis*)	70	40	35-100
Toxicodendron diversilobum	60	10	<1- 50
Baccharis pilularis	15	10	<1- 75
Rhamnus californica	28	10	<1- 50
Acer negundo	15	10	<1- 75
Rubus ursinus	15	<1	<1
Lonicera hispidula	15	<1	<1- 1
Ribes glutinosum	15	<1	<1
Herbs			
Pteridium aquilinum	15	15	<1-100
Conium maculatum	15	15	<1-100
Urtica holosericea	15	<1	<1- 5
Scrophularia atrata	15	<1	<1
Stachys bullata	15	<1	<1
Equisetum telmateia	15	<1	<1- 5
Sanicula crassicaulis	15	<1	<1- 1
Total Plant Cover		90	85-100

TABLE 3.2.5. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type chaparral

Summarizes _____ Presence Plots _____

Total Vascular Plant Species 20

Species Diversity (based on occurrence data) 11.0

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Adenostoma fasciculatum	100	30	1-75
Salvia mellifera	65	10	<1-25
Ceanothus ramulosus	65	5	<1-25
Arctostaphylos viridissima	55	35	<1-90
Quercus wislezenii	35	5	<1-25
Ceanothus impressus	35	<1	<1- 5
Artemisia californica	20	2	<1-15
Arctostaphylos rudis	20	<1	<1- 5
Haplopappus ericoides	10	<1	<1- 5
Dendromecon rigida	10	<1	<1- 5
Herbs			
Horkelia cuneata	20	<1	<1- 5
Gnaphalium ramosissima	20	<1	<1
Solidago californica	10	<1	<1- 5
Carpobrotus aequilaterus	10	<1	<1- 5
Total Plant Cover		85	75-90

TABLE 3.2.6. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type coastal sage scrub - normal and sparse phases

Summarizes 22 Presence Plots

Total Vascular Plant Species 63

Species Diversity (based on occurrence data) 35.0

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Artemisia californica	75	20	<1-90
Baccharis pilularis	60	10	<1-75
Diplacus longocensis	45	10	<1-75
Rubus ursinus	30	5	<1-50
Toxicodendron diversilobum	25	5	<1-75
Salvia mellifera	25	5	<1-50
Eriogonum parvifolium .	20	5	<1-75
Herbs			
Galium nutallii	30	<1	<1- 5
Avena fatua	25	10	<1-90
Scrophularia atrata	25	<1	<1-15
Salvia spathacea	25	1	<1-15
Gnaphalium ramosissima	25	<1	<1
Artemisia douglasiana	20	5	<1-50
Achillea millefolium	20	1	<1-15
Galium andrewsii	20	<1	<1- 5
Total Plant Cover		85	70-100

TABLE 3.2.7. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type coastal sage scrub - *Salvia leucophylla* phase

Summaries 6 Presence Plots

Total Vascular Plant Species 10

Species Diversity (based on occurrence data) 5.7

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Salvia leucophylla	100	65	50-90
Artemisia californica	100	10	<1-25
Encelia californica	60	15	<1-50
Baccharis pilularis	45	<1	<1- 5
Toxicodendron diversilobum	30	<1	<1- 5
Lotus scoparius	15	<1	<1
Herbs			
Elymus condensatus	45	1	<1- 5
Brassica rapa	15	1	1
Galium nuttallii	15	<1	<1
Marah fabaceus	15	<1	
Total Plant Cover		75	80-95

TABLE 3.2.8. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type coastal sage scrub - stabilized dune phase

Summarizes 12 Presence Plots

Total Vascular Plant Species 33

Species Diversity (based on occurrence data) 20.0

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Haplopappus ericoides	90	25	<1-75
Artemisia californica	65	15	<1-65
Lupinus chamissonis	50	5	<1-15
Senecio blochmaniae	50	3	<1-15
Eriogonum parvifolium	35	2	<1-15
Coreopsis gigantea	25	3	<1-15
Baccharis pilularis	15	3	<1-40
Herbs			
Croton californicus	35	5	<1- 5
Erysimum suffratescens	35	<1	<1- 5
Gnaphalium californicum	35	<1	<1
Corethrogyne filaginifolia	25	5	<1-60
Dudleya farinosa	25	2	<1-15
Phacelia ramosissima	25	<1	<1- 5
Scrophularia atrata	15	5	<1-40
Erigeron blochmanae	15	3	<1-40
Total Plant Cover		60	40-80

TABLE 3.2.9. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type wet soil scrub

Summarizes 3 Presence Plots

Total Vascular Plant Species 15

Species Diversity (based on occurrence data) 13.2

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and Herbs			
Salix spp. (*lasiandra* and *lasiolepis*)	65	50	<1-90
Toxicodendron diversilobum	65	35	<1-75
Baccharis pilularis	65	5	<1-15
Ribes speciosum	65	1	<1- 5
Clematis ligusticifolia	35	20	<1-65
Rubus ursinus	35	20	<1-65
Rhamnus californica	35	5	<1-15
Conicera involucrata	35	5	<1-15
Herbs			
Scrophularia atrata	100	20	<1-50
Artemisia douglasiana	65	15	<1-40
Elymus condensatus	35	30	<1-90
Venegasia carpesoides	35	5	<1-15
Satureja douglasii	35	1	<1- 3
Bromus rigidus	35	<1	<1
Helenium puberulum	35	<1	<1
Total Plant Cover		90	80-100

TABLE 3.2.10. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type coastal bluff

Summarizes 2 Presence Plots

Total Vascular Plant Species 10

Species Diversity (based on occurrence data) 10.2

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Eriogonum parvifolium	50	20	<1-40
Lupinus chamissonis	50	10	<1-15
Haplopappus venetus	50	10	<1-15
Herbs			
Eriophyllum staechadifolium	50	10	<1-15
Ambrosia chamissonis	50	10	<1-15
Frankenia grandifolia	50	10	<1-15
Carpobrotus edulis	50	1	<1- 3
Suaeda californica	50	<1	<1
Cirsium rhothophilum	50	<1	<1
Gascoul crystallinum	50	<1	<1
Total Plant Cover		50	40-60

TABLE 3.2.11. VEGETATION SUMMARY - PRESENCE PL . DATA

Vegetation type coastal strand

Summarizes 4 Presence Plots

Total Vascular Plant Species 10

Species Diversity (based on occurrence data) 8.2

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Haplopappus venetus			
Herbs			
Carpobrotus edulis	75	10	<1-15
Ambrosia chamissonis	75	4	<1-15
Abronia maritima	50	20	<1-60
Cakile maritime	50	1	<1- 5
Calystegia soldanella	25	<1	<1- 3
Chorizanthe spp.	25	<1	<1- 3
Corethrogyne filaginifolia	25	<1	<1- 3
Astragalus nutallii	25	<1	<1
Dudleya farinosa	25	<1	<1
Total Plant Cover		40	45-50

TABLE 3.2.12. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type coastal salt marsh

Summarizes 3 Presence Plots

Total Vascular Plant Species 3

Species Diversity (based on occurrence data) 3.0

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Herbs			
Frankenia grandifolia	100	45	25-75
Salicornia virginica	100	30	5-50
Jaumea carnosa	100	5	1-25
Total Plant Cover		100	100

TABLE 3.2.13. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type freshwater marsh

Summarizes 1 Presence Plots

Total Vascular Plant Species 5

Species Diversity (based on occurrence data) 5.0

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Salix lasiandra	100	15	15
Herbs			
Scirpus olneyi	100	60	60
Typha latifolia	100	3	3
Stachys bullata	100	3	3
Urtica holosericea	100	1	1
Total Plant Cover		100	100

TABLE 3.2.14. VEGETATION SUMMARY - PRESENCE PLOT DATA

Vegetation type annual grassland

Summarizes 12 Presence Plots

Total Vascular Plant Species 29

Species Diversity (based on occurrence data) 18.0

Occurrence and estimated Cover

Species	% Occ.	Cover Ave.	Cover Range
Trees and shrubs			
Haplopappus venetus	15	<1	<1- 5
Baccharis pilularis	15	<1	<1- 5
Herbs			
Erodium cicutarium	65	20	<1-90
Avena fatua	60	25	<1-90
Bromus rigidus	35	10	<1-50
Bromus rubens	25	10	<1-65
Medicago polymorpha	25	<1	<1- 5
Silybum marianum	15	3	<1-40
Amsinckia intermedia	15	<1	<1- 5
Sidalcea malvaeflora	15	<1	<1- 5
Foeniculum vulgare	10	15	<1-25
Juncus spp.	10	5	<1-90
Eremocarpus setigerus	10	3	<1-40
Rumex acetosella	10	1	<1-25
Bromus mollis	10	1	<1-25
Total Plant Cover		90	85-100

TABLE 3.2.15. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type Bishop pine forest

Summarizes 4 Permanent Quadrats 17, 19, 24 and 25

Cover based on 8 transects totalling 160 m.

% occurrence based on 36 circular plots.

Total Vascular Plant Species 24

Species Diversity (based on occurrence data) 10.5

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	Std. Dev.
Trees and shrubs			
Pinus muricata	86.0	40.0	17.1
Quercus wislizenii	69.0	12.50	10.2
Adenostoma fasciculatum	61.0	23.0	23.3
Arctostaphylos viridissima	53.0	7.5	10.7
Arctostaphylos viridissima x *rudis*	33.0	15.3	16.6
Vaccinium ovatum	28.0	3.3	6.5
Ceanothus ramulosus	19.0	2.5	5.0
Arctostaphylos rudis	19.0	0.75	1.5
Baccharis pilularis	14.0	0.3	0.5
Haplopappus ericoides	11.0	0.3	0.5
Diplacus longiflorus	8.0	0.3	0.5
Lotus scoparius	8.0	*	*
Salvia mellifera	8.0	*	*
Herbs			
Pteridium aquilinum	19.0	2.3	5.5
Miscellaneous herbs	17.0	*	*
Total Bare Ground		(18.5)	(12.9)
Total Plant Cover (100%-% bare ground)		(81.5)	( )

*These species appeared in the presence plots but not in the transects.

TABLE 3.2.16. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type Tanbark oak forest

Summarizes 2 Permanent Quadrats 27 and 28

Cover based on 4 transects totalling 70 m.

% occurrence based on 18 circular plots.

Total Vascular Plant Species 22

Species Diversity (based on occurrence data) 6.4

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	Std. Dev.
Trees and shrubs			
Lithocarpus densiflora	100.0	84.0	45-100
Vaccinium ovatum	94.0	75.5	27-100
Adenostoma fasciculatum	22.0	9.0	<1- 14
Arctostaphylos viridissima	17.0	8.0	<1- 12
Diplacus longiflorus	17.0	0.8	<1- 1
Baccharis pilularis	6.0	0.5	<1- 1
Ceanothus ramulosus	6.0	*	*
Ceanothus papillosus var. *roweanis*	6.0	*	*
Arctostaphylos rudis	6.0	*	*
Lotus scoparius	6.0	*	*
Herbs			
Pteridium aquilinum	28.0	*	*
Stellaria media	6.0	*	*
Heuchera micrantha	6.0	*	*
Symphoricarpus mollis	6.0	*	*
Galium andrewsii	6.0	*	*
Total Bare Ground		(1.5)	(0-3.0)
Total Plant Cover (100%-% bare ground)		(98.5)	( )

*These species appeared in the presence plots but not in the transects.

TABLE 3.2.17. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type foothill woodland

Summarizes 4 Permanent Quadrats 1, 2, 15 and 16

Cover based on 8 transects totalling 160 m.

% occurrence based on 36 circular plots.

Total Vascular Plant Species 55

Species Diversity (based on occurrence data) 20.0

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	Std. Dev.
Trees and shrubs			
Quercus agrifolia	100.0	52.3	2.9
Toxicodendron diversilobum	44.0	8.6	13.2
Artemisia californica	39.0	3.3	4.3
Rubus ursinus	22.0	6.8	7.8
Baccharis pilularis	22.0	1.0	2.0
Herbs			
Mixed grasses and forbs	**	25.0	30.8
Galium aparine	69.0	5.5	8.2
Pholistoma auritum	33.0	1.3	1.3
Montia perfoliata	33.0	*	*
Pteridium aquilinum	22.0	*	*
Horkelia cuneata	19.0	*	*
Stachys rigida	19.0	0.8	0.96
Conium maculatum	19.0	0.8	1.5
Viola quercetorum	16.5	*	*
Pterostegia drymarioides	16.5	*	*

Total Bare Ground	(33.3)	(21.5)
Total Plant Cover (100%-% bare ground)	(66.6)	( )

*Cover for these species lumped together under mixed grasses and forbes.

**Because this category represents a combination of species, it has no % occurrence.

TABLE 3.2.18. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type riparian woodland

Summarizes 4 Permanent Quadrats 4, 8, 14 and 22

Cover based on 8 transects totalling 132 m.

% occurrence based on 36 circular plots.

Total Vascular Plant Species 44

Species Diversity (based on occurrence data) 17.0

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	Std. Dev.
Trees and shrubs			
Salix spp.	78.0	67.8	45.7
Baccharis pilularis	45.0	4.3	5.1
Toxicodendron diversilobum	42.0	21.9	33.0
Ribes speciosum	22.0	1.2	0.9
Artemisia californica	19.0	0.5	1.0
Sambucus caerulea	19.0	*	*
Symphoricarpus mollis	14.0	2.6	5.3
Rubus ursinus	11.0	1.75	2.0
herbs			
Conium maculatum	27.0	8.3	13.2
Elymus condensatus	25.0	5.0	8.1
Urtica holosericea	25.0	1.0	2.1
Galium aparine	16.0	*	*
Artemisia douglasiana	14.0	7.1	9.0
Scrophularia atrata	8.0	0.3	0.5
Montia perfoliata	8.0	*	*
Total Bare Ground		(0)	(0)
Total Plant Cover (100%-% bare ground)		(100)	(0)

*These species appeared in the quadrat plots but not in the transects.

TABLE 3.2.19. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type chaparral

Summarizes 4 Permanent Quadrats 5, 12, 18 and 23

Cover based on 8 transects totalling 160 m.

% occurrence based on 36 circular plots.

Total Vascular Plant Species 29

Species Diversity (based on occurrence data) 14.0

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	Std. Dev.
Trees and shrubs			
Quercus wislizenii	75.0	28.5	26.5
Adenostoma fasciculatum	64.0	9.3	15.9
Arctostaphylos viridissima	58.0	19.5	23.7
Arctostaphylos rudis	53.0	15.[illegible]	31.5
Ceanothus ramulosus	36.0	3.0	3.5
Haplopappus ericoides	33.0	0.8	1.5
Baccharis pilularis	33.0	0.3	0.5
Ceanothus impressus	30.0	2.8	5.5
Diplacus longiflorus	29.0	1.0	2.0
Ceanothus papillosus var. roweanus	22.0	0.8	1.5
Herbs			
Pteridium aquilinum	22.0	2.5	5.0
Galium nuttallii	14.0	0.3	0.5
Horkelia cuneata	11.0	*	*
Total Bare Ground		(12.5)	(8.7)
Total Plant Cover (100%-% bare ground)		(87.5)	( )

*This species appeared in the presence plots but not in the transects.

TABLE 3.2.20. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type: coastal sage scrub - normal

Summarizes: 3 Permanent Quadrats: 20, 26 and 34

Cover based on 6 transects totalling 120 m.

% occurrence based on 27 circular plots.

Total Vascular Plant Species: 51

Species Diversity (based on occurrence data): 22.2

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	 Std. Dev.
Trees and shrubs			
Artemisia californica	96.0	26.0	20.5
Lotus scoparius	52.0	6.0	7.9
Baccharis pilularis	41.0	16.7	17.6
Haplopappus ericoides .	33.0	11.7	20.2
Salvia mellifera	33.0	4.7	8.1
Rhamnus californica	33.0	3.3	5.8
Herbs			
Pterostegia drymarioides	55.0	*	*
Anagallis arvensis	52.0	*	*
Gnaphalium ramosissimum	44.0	*	*
Erodium cicutarium	30.0	*	*
Solanum xantii	26.0	*	*
Achillea millefolium	22.0	*	*
Pteridium aquilinum	18.0	*	*
Camissonia micrantha	15.0	*	*
Bromus rubens	15.0	*	*
Total Bare Ground		(15.7)	(19.7)
Total Plant Cover (100%-% bare ground)		(84.3)	( )

*These species appeared in the presence plots but not in the transects.

TABLE 3.2.21. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type coastal sage scrub - *Salvia leucophylla* phase

Summarizes 3 Permanent Quadrats 29, 32 and 33

Cover based on 6 transects totalling 120 m.

% occurrence based on 27 circular plots.

Total Vascular Plant Species 23

Species Diversity (based on occurrence data) 7.8

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	Std. Dev.
Trees and shrubs			
Salvia leucophylla	100	68.0	13.2
Artemisia californica	100	12.0	5.6
Encelia californica	48.0	10.0	15.6
Baccharis pilularis	22.0	1.7	2.9
Lotus scoparius	22.0	*	*
Salvia mellifera x *leucophylla*	11.0	*	*
Herbs			
Miscellaneous herbs	37.0	*	*
Galium nutallii	14.0	0.7	1.2
Elymus condensatus	14.0	0.3	0.6
Anagallis arvensis	11.0	*	*
Marah fabaceus	7.0	*	*
Bromus rubens	7.0	*	*
Erodium cicutarium	7.0	*	*
Chenopodium californicum	7.0	*	*
Sanicula crassicaulis	4.0	*	*
Total Bare Ground		(19.7)	(9.1)
Total Plant Cover (100%-% bare ground)		(80.3)	( )

*These species appeared in the presence plots but not in the transects.

TABLE 3.2.22. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type coastal sage scrub - stabilized dune phase

Summarizes 4 Permanent Quadrats 9, 10, 13 and 21

Cover based on 36 transects totalling 160 m.

% occurrence based on 36 circular plots.

Total Vascular Plant Species 26

Species Diversity (based on occurrence data) 11.0

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	Std. Dev.
Trees and Shrubs			
Haplopappus ericoides	94.0	42.0	29.0
Senecio blochmanae	36.0	2.8	3.6
Lupinus chamissonis	30.0	10.3	15.1
Lotus scoparius	19.0	2.0	2.3
Herbs			
Corethrogyne filaginifolia	25.0	3.75	7.5
Carpobrotus aequilaterus	22.0	0.3	0.5
Descurainia pinnata	22.0	*	*
Camissonia micrantha	19.0	*	*
Gnaphalium ramosissimum	16.0	*	*
Pterostegia drymarioides	14.0	0.5	1.0
Festuca octoflora	14.0	0.3	0.5
Cryptantha clevelandii	11.0	0.3	0.5
Erisymum suffretescens	8.0	0.3	0.5
Chenopodium californicum	8.0	0.5	1.0
Phacelia ramosissima	8.0	0.3	0.5
Total Bare Ground		(36.5)	(21.2)
Total Plant Cover (100%-% bare ground)		(63.5)	( )

*These species appeared in the presence plots but not in the transects.

TABLE 3.2.23. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type coastal salt marsh

Summarizes 2 Permanent Quadrats 6 and 7

Cover based on 4 transects totalling 80 m.

% occurrence based on 18 circular plots.

Total Vascular Plant Species 3

Species Diversity (based on occurrence data) 2.0

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	 Std. Dev.
Herbs			
Salicornia virginica	100.0	92.5	85-100
Jaumea carnosa	50.0	15.5	1-30
Chenopodium californicum	5.0	*	*

Total Bare Ground	(0)	(0)
Total Plant Cover (100%-% bare ground)	(100)	( )

*This species appeared in the presence plots but not in the transects.

TABLE 3.2.24. VEGETATION SUMMARY - QUADRAT SAMPLING STATIONS

Vegetation type annual grassland

Summarizes 4 Permanent Quadrats 3, 11, 30 and 31

Cover based on 8 transects totalling 160 m.

% occurrence based on 36 circular plots.

Total Vascular Plant Species 38

Species Diversity (based on occurrence data) 21.0

Cover and Occurrence Data Species	% Occ.	Ave. % Cover Mean	Std. Dev.
Trees and shrubs			
Artemisia californica	28.0	1.0	1.4
Eucalyptus spp.	22.0	*	*
Herbs			
Mixed grasses and forbs	**	86.5	11.0
Bromus rigidus	75.0	*	*
Erodium cicutarium	55.0	*	*
Cryptantha clevelandii	28.0	*	
Hypochoeris glabra	25.0	*	*
Medicago hispida	25.0	*	*
Amsinckia intermedia	25.0	*	*
Lupinus nanus	22.0	*	*
Orthocarpus purpurascens	22.0	*	*
Eschscholzia californica	22.0	*	*
Brassica rapa	22.0	*	*
Silybum marianum	20.0	*	*
Rumex acetosella	17.0	*	*
Hordeum depressum	17.0	*	*
Total Bare Ground		(11.5)	(11.2)
Total Plant Cover (100%-% bare ground)		(88.5)	( )

*Cover for these species lumped together under mixed grasses and forbs.

**Because this category represents a combination of species, it has no % occurrence.

That is, the standard deviation was calculated with degrees of freedom being one less than the number of quadrats, while the mean was calculated by dividing cover of each species totalled for all quadrats by the number of quadrats.

Because inclusion of a particular species was decided on the basis of its occurrence, there are a number of species in various summaries for which there are no cover data. This is not the result of blunder but arises because of the variation from point to point and because the plots tended to pick up more species than did the transect samples. These cases, and certain other similar ones are indicated by footnote.

The figure for total bare ground represents the length of transect which traversed ground surface without plant cover of any kind. This figure, subtracted from 100 percent gives the surface area covered by plants. See Section 3.1.4.2. for details.

4. - WILDLIFE ANALYSES

4.1. Methods

4.1.1. Terrestrial Vertebrates. A total of 34 quadrats were established on Vandenberg AFB. Each quadrat was selected on the basis of homogeneity of major vegetation types, avoiding transitional stages or ecotones, e.g., components of both chaparral and coastal sage scrub. Nearly all of the 34 quadrats were delimited by 80 x 80 foot or 160 x 160 foot plots depending on the complexity and density of vegetation in the sampling area. Nine 5-gallon metal cans were buried more or less equidistantly and level with the ground to serve as pitfall traps. Pitfall trap numbers one through nine were labelled on 1/2 x 14 x 14 inch plywood covers. Four, 2 x 2 x 2 inch wooden blocks were fastened on each corner of the cover, allowing a two inch opening from ground to trap cover for the entry of small vertebrates. The plywood covers also provide protection from direct sunlight and an escape shelter from large predators. The bottom of each pitfall trap was covered with two inches of soil in an attempt to simulate natural conditions. Traps were baited with wild bird seed and checked every 4-5 days. Animals were identified to species, sexed, aged (hatchling, juvenile, adult), noted as dead or alive, marked (mammals only), and released. The pitfall trap has been an effective reptile and small mammal sampling device for over 30 years (ref. 15, 16). Voucher specimens were deposited at the San Diego Natural History Museum.

Sherman traps were employed at each quadrat for small mammal captures as well as species, e.g. Woodrats, Kangaroo Rats, which readily escape from pitfall traps. One Sherman trap was associated with each corner pitfall trap and the center pitfall, i.e. traps 1, 3, 5, 7, 9. Traps were usually set in

the afternoon, baited with wild bird seed, and checked the following morning. Sherman traps were employed for a total of two trap nights/quadrat/sampling period, thus insuring greater mark and recapture of individuals within each population. This also provided a more realistic estimate of population size, movements, and diversity for small mammals.

For purposes of locating quadrat sampling stations, monuments were emplaced near a corner pitfall trap, (i.e. 1, 3, 7, 9) visible from an access road, trail, or foot path. Each monument consisted of a 2 x 24 inch galvanized pipe buried in approximately 12 inches of concrete. The remaining 12 inches of unburied pipe was painted bright red and is readily noticeable in the field. Inside the monument is a plastic laminated 2 x 3 inch card listing the following information: 1) San Diego State University Ecology Survey, VAFB, 2) emplacement data of monument, 3) quadrat number, 4) grid cell location, 5) approximate elevation, 6) slope exposure, and 7) vegetation type. A heavy galvanized cap was tightly fastened to each pipe. The monument number (= quadrat number) and the letters "SDSU" were stamped on each cap for reference. Specific locations of these permanent stations are given in Appendix A (section 6).

A problem exists in comparison of capture frequencies, and subseqeuntly relative abundance estimates, when combining pitfall captures of small mammals with Sherman live trap estimates. This exists because the probability of capture is different for a given species between these two sampling techniques. Table 4.1.1 analyzes the capture frequencies by both techniques for 12 species of small mammals captured during a portion of the study. Five species (two shrews, broad-footed mole, pocket gopher, and Heerman's kangaroo rat) were captured only in pitfall traps (100%). Less than 2% of the dusky-footed woodrats were captured in pitfall traps, and the other six species (all rodents)

TABLE 4.1.1. Capture Frequencies of Small Mammals by Trapping Method (1st and 2nd quarters only), All Quadrats Combined. Catch per Unit Effort (A-C) Expressed in Animals per 1000 Trap-days (TN).

Species	Total Number Captured	Number of Pitfalls	Number Sherman	A. Pitfall: #/1000 TN	B. Sherman: #/1000 TN	C. Pitfall #/1000 TN + Sherman #/1000 TN	D. Proportion of Population at Risk	% Total Captures by Pitfall
[illegible]	36	36	0	2.14	0	2.14	1.00	100 %
[illegible]	17	17	0	1.01	0	1.01	1.00	100
[illegible]	1	1	0	0.06	0	0.06	1.00	100
Thommomys umbrinus	11	11	0	0.65	0	0.65	1.00	100
Dipodomys agilis	31	4	27	0.24	39.72	40.0	0.006	12.9
[illegible]	1	1	0	0.06	0	0.06	1.00	100
Perognathus californicus	44	23	21	1.37	30.89	32.26	0.043	52.3
Microtus californicus	53	48	5	2.85	7.36	10.21	0.279	90.6
Neotomodontomys megalotis	54	51	3	3.03	4.41	7.44	0.407	94.4
Peromyscus maniculatus	432	180	252	10.7	370.6	381.4	0.028	41.7
Peromyscus californicus	85	4	81	0.24	119.2	119.4	0.002	4.7
*Neotoma fuscipes**	64	1	63	<0.001	34.31	34.31	<0.001	1.6
TOTALS (T), $\bar{X} \pm S_d$	T=829	T=377	T=452	T=22.35	T=617.1	T=639.5	0.48 ± .47	66.5 ± 41.2

*includes 3rd quarter captures

D - calculated as A ÷ C; proportion of n/1000 TN at risk to pitfall traps

were captured in varying percentages between 5 and 94% in pitfalls (Table 4.1.1). Thus, pitfall traps are a more complete sampling procedure for small mammals in terms of detecting species presence.

The differences between capture frequencies cited for the species listed in Table 4.1.1 raise the question of possible seasonal variation in catchability between the two sampling methods. To address this question, data on capture frequencies for the deer mouse (*Peromyscus maniculatus*), as the most abundant small mammal encountered, were stratified by season and habitat (Table 4.1.2). No significant differences between seasons (all habitats combined) was found; however, some variation between certain habitat types (yearly average) were noted (Table 4.1.2). This variability in capture frequency between pitfall and Sherman methods was not significant when these habitats were grouped physiognomically (Table 4.1.2). Thus it appears likely that the capture frequency between the two sampling methods used is independent of season and general habitat type for the deer mouse. This assumption was extended to all species of small mammals.

4.1.2. Avifauna. Standard observational techniques were used by the entire field crew in resolution of the number of species of birds found in Vandenberg AFB (section 4.3). Quantitative estimates of bird utilization, as relative abundance by season, were made at each of the permanent sampling stations described in section 4.1.1. Birds were counted at each quadrat by walking two transects (200 feet each) which intersected at right angles in the center of the quadrat (Station 5). All individuals seen or identified by song were counted. Ten minutes per transect were allowed; relative abundances for each species were calculated on the basis of numbers/man-hour of effort.

TABLE 4.1.2. Capture Proportions of the Deer mouse (*Peromyscus maniculatus*) by Habitat Types, Pitfall Versus Sherman Traps.

		1. Bishop Pine Forest	2. Tan Oak Forest	3. Oak Woodland	4. Riparian Woodland	5. Chaparral	6. Coastal Sage Normal Phase	7. Coastal Sage Dune Phase	8. Coastal Sage Purple Sage Phase	9. Annual Grassland	10. Coastal Salt Marsh	All Woodlands (1-4)	All Coastal Sage (6-8)	All Habitats (1-10)	
1st Qtr	Total[1]	1	10	12	21	12	39	39	25	45	13	44	103	217	P/T: $\bar{X}\pm S_d$,
	Ptfl.[2]	1	0	1	14	4	15	11	6	30	6	16	32	88	all habitats
	P/T[3]	1.0	0.0	0.08	0.67	0.33	0.39	0.28	0.24	0.67	0.46	0.36	0.31	0.41	0.40 ± 0.26
2nd Qtr	Total	6	14	16	17	16	26	63	29	28	(36)	53	118	215	P/T: $\bar{X}\pm S_d$,
	Ptfl.	2	4	6	5	2	19	31	11	12	--	17	61	92	all habitats
	P/T	0.33	0.29	0.38	0.29	0.13	0.73	0.49	0.38	0.43	--	0.32	0.52	0.43	0.39 ± 0.15
3rd Qtr	Total	10	8	28	48	29	37	43	18	19	(11)	94	117	240	P/T: $\bar{X}\pm S_d$,
	Ptfl.	2	0	11	24	9	17	15	6	6	--	37	44	90	all habitats
	P/T	0.20	0.0	0.39	0.50	0.31	0.46	0.35	0.33	0.32	--	0.39	0.38	0.38	0.33 ± 0.13
4th Qtr	Total	6	4	7	30	4	12	34	21	14	11	47	67	143	P/T: $\bar{X}\pm S_d$,
	Ptfl.	1	0	6	18	0	5	18	8	6	2	25	31	64	all habitats
	P/T	0.17	0.0	0.86	0.6	0.0	0.42	0.53	0.38	0.43	0.18	0.53	0.46	0.48	0.36 ± 0.27
Yr Ttls	Total	17	36	63	116	61	114	179	93	106	24	238	405	815	P/T: $\bar{X}\pm S_d$,
	Ptfl.	4	4	24	61	15	56	75	31	54	8	95	168	334	all habitats
	P/T	0.24	0.11	0.38	0.53	0.25	0.49	0.42	0.33	0.51	0.33	0.40	0.41	0.41	0.36 ± 0.13
$\bar{X}^*$, P/T		0.43	0.07	0.43	0.52	0.19	0.50	0.41	0.33	0.46	0.32	0.40	0.42	0.43	Overall $\bar{X}\pm S_d$(P/T)
S_d^*, P/T		±0.39	±0.15	±0.32	±0.17	±0.16	±0.16	±0.12	±0.07	±0.15	--	±0.09	±0.09	±0.04	0.37 ± .23 (n=38)

*excluding year totals

1. total = total captures, pitfall plus 2 nights Sherman trapping
2. pitfall = pitfall captures only
3. P/T = proportion of captures by pitfall traps; 1-P/T = proportion of captures by Sherman traps

Quadrats within the same vegetational unit were grouped together prior to calculation.

4.1.3. Computational Methods. Indexes of relative abundance for terrestrial vertebrates were calculated on the basis of numbers taken per 1000 trap days. Trap days were determined by the number of days each method (pitfall or Sherman) was in operation times the number of traps, expressed in units of 1000 trap days. Sherman trap and pitfall captures were treated separately.

An index of species diversity was computed for certain descriptive and comparative advantages. The index chosen was Simpson's diversity index, D_S (ref. 17), given as:

$$D_S = \frac{N(N-1)}{k \sum_{i=1} n_i(n_i-1)} \qquad (1$$

where N = total number of individuals of all species; n_i = number of individuals of the ith species. Estimates of relative abundance were used for values of n_i (section 4.5). The interpretation of this index is generally universally related to the probability that two individuals drawn randomly from the same community are of the same species. Thus, large. values of D_S are considered indicative of higher ecological diversity.

4.2. Herpetofauna

Vandenberg AFB comprises an area of approximately 100,000 acres with a 30-mile coastline extending from Point Sal south to Jalama Beach. Such a diverse area with its Bishop Pine and Tanbark Oak forests, oak and riparian woodland, chaparral, sagebrush scrub, and unique coastal sage scrub stabilized dunes supports several species of amphibians and reptiles. McKeown (ref. 18)

lists 15 amphibian and 33 reptile species for Santa Barbara County, excluding three species of sea turtles which may potentially occur in waters north of Point Conception. Vandenberg AFB may support 13 amphibian and 27 reptile species, including sea turtles (Tables 4.2.1 and 4.2.2), of which 7 and 16 species, respectively, have been observed. Section 4.5 is a summary of relative abundance and diversity of amphibians and reptiles sampled in each vegetation type.

Amphibians and reptiles are generally secretive organisms requiring considerable effort to document their presence. Being efficient ectotherms, their surface activity depends on both biotic and abiotic environmental parameters. The most important of these are climatological factors such as precipitation and air temperature.

Most amphibians may be observed during the winter months (November-March) when sufficient rainfall is conducive to surface activity. Coincident with surface activity is the reduction of water lost through the skin during periods of rainfall. In summer months amphibians are found in close proximity to water or confined to a moist place, i.e. under logs, rocks, etc. Furthermore, breeding occurs during winter and spring months. At this time, male frogs and toads produce specific vocalizations to attract females to a breeding site. Search for amphibians at Vandenberg AFB occurred during winter and early spring when surface and breeding activity was greatest.

Generally, reptiles are less dependent on dermal absorption of water than amphibians. They typically have horny, dry, nonglandular skin that resists desiccation (ref. 19). They differ from amphibians in being more tolerant to high temperatures due to thermal selectivity, i.e. narrower range of temperatures

TABLE 4.2.1. Checklist of Observed and Expected Amphibians at Vandenberg AFB.

Class Amphibia
- Order Caudata
  - Family Ambystomidae
    - *Ambystoma tigrinum* (Tiger Salamander)°
  - Family Salamandridae
    - *Taricha torosa* (California Newt)°
  - Family Plethodontidae
    - *Ensatina eschscholtzii* (Ensatina)+
    - *Batrachoseps attenatus* (California Slender Salamander)+
    - *Aneides lugubris* (Arboreal Salamander)+
- Order Anuar
  - Family Pelobatidae
    - *Scaphiopus hammondi* (Western Spadefoot)
  - Family Bufonidae
    - *Bufo boreas* (Western Toad)+
    - *Bufo microscaphus* (Southwestern Toad)*
  - Family Hylidae
    - *Hyla regilla* (Pacific Treefrog)+
    - *Hyla Californiae* (California Treefrog)°
  - Family Ranidae
    - *Rana aurora* (Red-legged Frog)+*
    - *Rana boylei* (Foothill Yellow-legged Frog)°
    - *Rana catesbeiana* (Bullfrog)+°

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* Species protected by California Fish and Game Code, 1975

o Species regulated by California Fish and Game Code, 1975

+ Species observed furing the survey.

TABLE 4.2.2. Checklist of Observed and Expected Reptiles at Vandenberg AFB.

Class Reptilia
- Order Chelonia
  - Family Testudinidae
    - *Clemmys marmorata* (Western Pond Turtle)+o
  - Family Chelonidae
    - *Chelonia mydas* (Green Turtle)
    - *Caretta caretta* (Loggerhead)
  - Family Dermochelyidae
    - *Dermochelys coricea* (Leatherback)●
- Order Squamata: Suborder Sauria
  - Family Iguanidae
    - *Sceloporus occidentalis* (Western Fence Lizard)+
    - *Uta stansburiana* (Side-blotched Lizard)+
    - *Phrynosoma coronatum* (Coast Horned Lizard)+o
  - Family Scincidae
    - *Eumeces skiltonianus* (Western Skink)+
  - Family Teidae
    - *Cnemidophorus tigris* (Western Whiptail)
  - Family Anguidae
    - *Gerrhonotus multicarinatus* (Southern Alligator Lizard)+
  - Family Anneillidae
    - *Anniella pulchra* (California Legless Lizard)+o
- Order Squamata: Suborder Serpentes
  - Family Colubridae
    - *Diadophis punctatus* (Ringneck Snake)+
    - *Contia tenuis* (Sharp-tailed Snake)
    - *Masticophis lateralis* (Striped Racer)+
    - *Masticophis flagellum* (Coachwhip)
    - *Coluber constrictor* (Racer)+
    - *Salvadora hexalepis* (Western Patch-nosed Snake)
    - *Pituophis melanoleucus* (Gopher Snake)+
    - *Lampropeltis zonata* (California Mountain Kingsnake)o
    - *Lampropeltis getulus* (Common Kingsnake)+o
    - *Rhinocheilus lecontei* (Long-nosed Snake)
    - *Thamnophis sirtalis* (Common Garter Snake)+
    - *Thamnophis elegans* (Western Terrestrial Garter Snake)+
    - *Thamnophis couchi* (Western Aquatic Garter Snake)+o
    - *Tantilla planiceps* (Western Black-headed Snake)
    - *Hypsiglena torquata* (Night Snake)
  - Family Crotalidae
    - *Crotalus viridis* (Western Rattlesnake)+

● Species listed as endangered by U.S Fish and Wildlife Service, 1974.

o Species regulated by California Fish and Game Code, 1975.

+ Species observed during the survey.

for "normal" activity. Because of their tolerance to high temperatures, most reptiles are active during late spring and summer. Likewise, offspring of the year appear in spring through mid-summer.

The status of sea turtles occurring off the coast of Vandenberg AFB still remains uncertain. Sea turtles are predominantly widespread in warm seas. All species come to shore to lay eggs in tropical and subtropical beaches throughout the world. Their occurrence off the coast of Vandenberg AFB are probably uncommon. Records from Point Conception north are incidental and, in some cases, dubious (ref. 19). Species which may occur off Vandenberg AFB as seasonal visitors or waifs are as follows;

1. Green Turtle (*Chelonia mydas*): On the Pacific coast this species is common as far north as San Quintin Bay, Baja California and occasionally reaches bays along southern California. According to Stebbins (ref. 19), "...it was formerly common in San Diego Bay, and there are old dubious records from San Francisco". This species has been the subject of a conservation program for prevention of their decline.
2. Loggerhead Turtle (*Caretta caretta*): This species ranges north on the Pacific coast to southern California and upper Gulf of California. It has been observed in open ocean along the California coast as well as in bays, lagoons, estuaries, salt marshes, and river mouths. Its occurrence at Vandenberg AFB is expected on an irregular basis.

3. Leatherback (*Dermochelys coricea*): This species, weighing up to 1,500 pounds, is occasional as far north as Vancouver Island, British Columbia (ref. 20). Several records exist for California waters and may occasionally occur off Vandenberg AFB. The Leatherback is recognized as endangered by the U.S. Department of Interior, Fish and Wildlife Service (ref. 21).

4.3. Avifauna

The taxonomic check-list of avian species expected to occur in the region of Vandenberg AFB is given in Table 4.3.1, including accepted common names as species numbers from the A.O.U. check-list of North American Birds (ref. 22, 23). Section 4.5 is a summary of relative abundance and diversity of bird species censused in each vegetation type. The content of Table 4.3.1 was derived from Grinnell and Miller (ref. 24).

Due to the fact that birds are very mobile, several species may be seen in more than one plant community. This is also a result of the behavioral preferences shown by birds toward habitat selection. Several species may only require trees, shrubs, or grasslands. For this reason wherever trees are present one may find a particular species even though it is a riparian woodland, foothill woodland, or pine forest.

4.4. Mammalian Fauna

4.4.1. General aspects. The taxonomic check-list of terrestrial mammals expected to occur in the Vandenberg AFB area is given in Table 4.4.1; this table is based on information given by Hall and Kelson (ref. 25). Systematic observations of tracks, scats, sightings and life-trap results are recorded to

TABLE 4.3.1. Checklist of Birds in the Region of Vandenberg AFB.

I. WATER AND SHORE BIRDS

Order Gaviformes (Loons)
Family Gavidae (Loons)
7 *Gavia immer* (Common Loon)
10 *Gavia arctica pacifica* (Arctic Loon)
11+ *Gavia stellata* (Red-throated Loon)

Order Podicipediformes (Grebes)
Family Podicipedidae (Grebes)
3 *Podiceps auritus* (Horned Grebe)
2 *Podiceps grisegena* (Red-necked Grebe)
4+ *Podiceps caspicus californicus* (Eared Grebe)
1+ *Aechmorphorus occidentalis* (Western Grebe)
6+ *Podilymbus podiceps* (Pied-billed Grebe)

Order Procellariiformes (Tube-nosed Swimmers)
Family Procellaridae (Shearwaters, Fulmars)
95+ *Puffinus griseus* (Sooty Shearwater)
Family Pelecanidae (Pelicans)
127+ *Pelecanus occidentalis* (Brown Pelican)
Family Phalacrocoracidae (Cormorants)
120c+ *Phalacrocorax auritus* (Double-crested Cormorant)
122+ *Phalacrocorax penicillatus* (Brandt's Cormorant)

Order Ciconiiformes (Herons, Bitterns, and Ibeses)
Family Ardeidae (Herons and Bitterns)
194d+ *Ardea herodias* (Great Blue Heron)
201c+ *Butorides virescens* (Green Heron)
196+ *Casmerodius albus* (Common Egret)
202+ *Nycticorax nycticorax* (Black-crowned Night Heron)
190+ *Botarus lentiginosus* (American Bittern)

Order Anseriformes (Ducks, Geese and Swans)
Family Anatidae (Ducks, Geese and Swans)
173+ *Branta bernicla* (Brandt)
172+ *Branta canadensis* (Canada Goose)
132+ *Anas platyrhynchos* (Mallard)
143+ *Anas acuta* (Pintail)
139+ *Anas crecca* (Green-winged Teal)
141+ *Anas cyanoptera* (Cinnamon Teal)
137+ *Anas americana* (American Wigeon)
149+ *Aytha affinis* (Lesser Scaup)
142+ *Anas clypeata* (Northern Shoveler)
147+ *Aythya valisineria* (Canvas Back)
153+ *Bucephala albeola* (Buffle-head)
165 *Melanitta deglandi* (White-winged Scooter)
166+ *Melanitta perspicillata* (Surf Scooter)
163 *Melanitta nigra* (Black Scooter)
167+ *Oxyura jamaicensis* (Ruddy Duck)

TABLE 4.3.1. cont.

Order Falconiformes (Vultures, Hawks and Eagles)
- Family Cathartidae (American Vultures)
  - 325a*+ *Cathartes aura* (Turkey Vulture)
  - 324R *Gymnogyps Californianus* (California Condor)
- Family Accipitridae (Hawks and Eagles)
  - 328*+ *Elanus leucurus* (White-tailed Kite)
  - 331*+ *Circus cyaneus* (Marsh Hawk)
  - 332*+ *Accipiter striatus* (Sharp-shinned Hawk)
  - 333*+ *Accipter cooperii* (Cooper's Hawk)
  - 339b*+ *Buteo lineatus* (Red-shouldered Hawk)
  - 337b*+ *Buteo jamaicensis* (Red-tailed Hawk)
  - 349*+ *Aquila chrysaetos* (Golden Eagle)
  - 352a* *Haliaeetus leucocephalus* (Bald Eagle)
- Family Pandionidae
  - 364* *Pandion haliaetus* (Osprey)
- Family Falconidae (Falcons)
  - 356aR *Falco peregrinus* (Peregrine Falcon)
  - 360+ *Falco sparverius* (American Kestrel)

Order Gruiformes
- Family Rallidae (Rails, Gallenules and Coots)
  - 210R *Rallus longirostris* (Clapper Rail)
  - 212+ *Rallus limicola* (Virginia Rail)
  - 214+ *Porzana carolina* (Sora)
  - 216.1R *Laterallus jamaicensis* (Black Rail)
  - 221+ *Fulica americana* (American Coot)
  - 219 *Gallinula chloropus* (Common Gallinule)

Order Charadriformes (Shore Birds, Gulls and Terns)
- Family Haematopodidae (Oyster Catchers)
  - 287+ *Haematopus bachmani* (Black Oyster-catcher)
- Family Charadriidae (Plovers and Turnstones)
  - 270+ *Pluvialis squatarola* (Black-bellied Plover)
  - 272 *Pluvialis dominica* (American Golden Plover)
  - 274+ *Charadrius semipalmatus* (Semi-palmated Plover)
  - 278+ *Charadrius alexandrinus* (Snowy Plover)
  - 273+ *Charadrius vociferus* (Killdeer)
  - 281 *Charadrius montana* (Mountain Plover)
  - 282 *Aphriza virgata* (Surf Bird)
  - 283+ *Arenaria interpres* (Ruddy Turnstone)
  - 284+ *Arenaria melanocephala* (Black Turnstone)
- Family Scolopacidae (Snipes, Sandpipers and Curlews)
  - 264+ *Numenius americanus* (Long-billed Curlew)
  - 267+ *Numenius phaeopus* (Whimbrel)
  - 249+ *Limosa fedoa* (Marbled Godwit)
  - 255+ *Tringa flavipes* (Lesser Yellow Legs)
  - 254+ *Tringa melanoleucus* (Greater Yellow Legs)
  - 256a+ *Tringa solitaria* (Solitary Sandpiper)
  - 263+ *Actitis macularia* (Spotted Sandpiper)

TABLE 4.3.1. cont.

258+ *Catoptrophorus semipalmatus* (Willett)
249+ *Heteroscelus incanum* (Wandering Tattler
231b+ *Limnodromus griseus* (Short-billed Dowitcher)
232 *Limnodromus scolapaceus* (Long-billed Dowitcher)
234 *Calidris canutus* (Knot)
248+ *Califris alba* (Sanderling)
247+ *Calidris mauri* (Western Sandpiper)
242+ *Calidris minutilla* (Least Tern)
241 *Calidris bairdii* (Baird's Sandpiper)
239 *Calidris melanotos* (Pectoral Sandpiper)
243a *Calidris alpina* (Dunlin)
230+ *Capella gallinago* (Snipe)

Family Recurvirostridae (Avocets and Stilts)
226+ *Himantopus mexicanus* (Black-necked Stilt)
225 *Recurvirostra americana* (American Avocet)

Family Phalaropodidae (Phalaropes)
222 *Phalaropus fulicarius* (Red Phalarope)
224+ *Steganopus tricolor* (Wilson's Phalarope)
223 *Lobipes lobatus* (Northern Phalarope)

Family Stercorariidae (Skuas and Jaegers)
37 *Stercorarius parisiticus* (Parasitic Jaeger)

Family Laridae (Gulls and Terns)
57+ *Larus heermanni* (Heermann's Gull)
54+ *Larus delawarensis* (Ring-billed Gull)
55 *Larus canus* (Mew Gull)
51b+ *Larus argentatus* (Herring Gull)
53+ *Larus californicus* (California Gull)
42.1 *Larus hyperboreus* (Glaucous Gull)
60+ *Larus philadelphia* (Bonaparte's Gull)
49b+ *Larus occidentalis* (Western Gull)
40a *Rissa tridactyla* (Black-legged Kittiwake)
62a *Xema sabini* (Sabine's Gull)
77 *Chlidonias nigra* (Black Tern)
64+ *Hydroprogne caspia* (Caspian Tern)
69+ *Sterna forsteri* (Forster's Tern)
74aR+ *Sterna albifrons* (Least Tern)
65+ *Thalasseus maximus* (Royal Tern)
30a+ *Uria aalge* (Common Murre)
29+ *Cepphus columba* (Pigeon Guillemot)

II. LAND BIRDS

Order Galliformes (Gallanaceous Birds)
Family Phasianidae (Quail Partridges and Pheasants)
294a+ *Lophortyx californicus* (California Quail)

Order Columbiformes (Pigeons and Doves)
Family Columbidae (Pigeons and Doves)
312b *Columba fasciata* (Band-tailed Pigeon)
313.1+ *Colomba livia* (Rock Dove)
316a+ *Zenaida macroura* (Mourning Dove)

TABLE 4.3.1. cont.

Order Cuculiformes (Cuckoo-like Birds)
Family Cuculidae (Cuckoos, and Roadrunners)
387aR *Coccyzus americanus* (Yellow-billed Cuckoo)
385+ *Geococcyx californianus* (Roadrunner)

Order Strigiformes (Owls)
Family Tytonidae (Barn Owls)
365+ *Tyto alba* (Barn Owl)
Family Strigidae (Typical Owl)
373 *Otus asia* (Screech Owl)
375+ *Bulbo virginianus* (Great Horned Owl)
379 *Glaucidium gnoma* (Pigmy Owl)
367 *Asio flammeus* (Short-eared Owl)
378R+ *Speotyto cunicicularia* (Burrowing Owl)

Order Captrimulgiformes (Goat Sucker-like Birds)
Family Captrimulgidae
418+ *Phalaenoptilus nuttallii* (Poor-Will)

Order Apodiformes (Swifts and Hummingbirds)
Family (Apodidae (Swifts)
425+ *Aeronautes saxatilis* (White-throated swift)
Family Trochilidae (Hummingbirds)
429+ *Archilochus alexandri* (Black-chinned Hummingbird)
431+ *Calypte anna* (Anna's Hummingbird)
434+ *Selasphorus sasin* (Allen's Hummingbird)

Order Coraciiformes (Roller-like Birds)
Family Alcedinidae (Kingfishers)
390+ *Megaceryle alcyon* (Belted Kingfisher)
Family Picidae (Woodpeckers)
413+ *Colaptes auratus* (Common Flicker)
407+ *Melanerpes formicivorus* (Acorn Woodpecker)
408 *Asyndesmys lewis* (Lewis Woodpecker)
393 *Dendrocopes villosus* (Hairy Woodpecker)
394+ *Dendrocopos pubescens* (Downy Woodpecker)
397+ *Dendrocopos nuttallii* (Nuttall Woodpecker)

Order Passeriformes (Perching Birds
Family Tyrannidae (Flycatchers)
448+ *Tyrannus vociferans* (Cassin Kingbird)
466+ *Empidonax traillii* (Willow Flycatcher)
469 *Empidonax wrightii* (Gray Flycatcher)
464+ *Empidonax difficilis* (Western Flycatcher)
462+ *Contopus sordidulus* (Western Wood Pewee)
459 *Nuttallornis borealis* (Olive-sided Flycatcher)
Family Alaudidae (Larks)
474+ *Eremophila alpestris* (Horned Lark)

TABLE 4.3.1. cont.

Family Hirundinidae (Swallows)
- 615+ *Tachycineta thalassina* (Violet-green Swallow)
- 614 *Iridoprocne bicolor* (Tree Swallow)
- 616 *Riparia riparia* (Bank Swallow)
- 612+ *Petrochelidon pyrrhonota* (Cliff Swallow)
- 611+ *Progne subis* (Purple Martin)

Family Corvidae (Jays, Magpies and Crows)
- 478 *Cyanocitta stelleri* (Steller's Jay)
- 481+ *Aphelocoma coerulescens* (California Scrub Jay)
- 476+ *Pica nuttallii* (Yellow-billed Magpie)
- 486 *Corvus corax* (Common Raven)
- 488+ *Corvus brachyrhynchos* (Common Crow)

Family Paridae (Tits)
- 733+ *Parus inornatus* (Plain Titmouse)
- 743+ *Psaltriparus minimus* (Common Bush-tit)

Family Sittidae (Nuthatches)
- 727+ *Sitta carolinensis* (White-breasted Nuthatch)

Family Chamaeidae (Wren-tits)
- 742+ *Chamaea fasciata* (Wren-tit)

Family Cinclidae (Dippers)
- 701 *Cinclus mexicanus* (Dipper)

Family Troglodytidae (Wrens)
- 722 *Troglodytes troglodytes* (Winter Wren)
- 719+ *Thryomanes bewickii* (Bewick's Wren)
- 725+ *Telmatodytes palustris* (Long-billed Marsh Wren)
- 715 *Salpinctes obsoletus* (Rock Wren)

Family Mimidae (Mockingbirds and Thrashers)
- 703+ *Mimus polyglottos* (Mockingbird)
- 710+ *Toxostoma redivivum* (California Thrasher)

Family Turdidae (Thrushes)
- 761 *Turdus migratorius* (American Robin)
- 763 *Ixoreus naevius* (Varied Thrush)
- 759 *Catharus guttatus* (Hermit Thrush)
- 758+ *Catharus ustulatus* (Swainson's Thrush)
- 767+ *Sialia mexicana* (Western Bluebird)

Family Sylviidae (Gnatcatchers and Kinglets)
- 748 *Regulus satrapa* (Golden-crowned Kinglet)
- 749+ *Regulus calendula* (Ruby-crowned Kinglet)

Family Bombycillidae (Waxwings)
- 619 *Bombycilla cedrorum* (Cedar Waxwing)

Family Laniidae (Shrikes)
- 622+ *Lanius ludovicianus* (Loggerhead Shrike)

Family Vireonidae (Vireos)
- 632+ *Vireo huttoni* (Hutton's Vireo)
- 627 *Vireo gilvus* (Warbling Vireo)

TABLE 4.3.1. cont.

Family Parulidae (Wood Warblers)
- 636 *Mniotilta varia* (Black and White Warbler)
- 646+ *Vermivora celata* (Orange-crowned Warbler)
- 652+ *Dendroica petechia* (Yellow Warbler)
- 656+ *Dendroica coronata* (Yellow Rumped Warbler)
- 669 *Dendroica occidentalis* (Hermit Warbler)
- 681+ *Geothylpis tricas* (Yellow-throat)
- 685+ *Wilsonia pusilla* (Wilson's Warbler)

Family Icteridae (Orioles, Blackbirds and Meadowlarks)
- 501+ *Sturnella neglecta* (Western Meadowlark)
- 493 *Sturnus vulgaris* (Starling)
- 497 *Xanthocephalus xanthocephalus* (Yellow-headed Blackbird)
- 498+ *Agglaius phoeniceus* (Red-winged Blackbird)
- 505+ *Icterus cucullatus* (Hooded Oriole)
- 504 *Icterus parisorum* (Scott Oriole)
- 508+ *Icterus galbula* (Northern Oriole)
- 510+ *Euphagus cyanocephalus* (Brewer's Blackbird)
- 495+ *Molothrus ater* (Brown-headed Cowbird)

Family Thraupidae (Tanagers)
- 607+ *Piranga ludoviciana* (Western Tanager)

Family Fringillidae
- 596+ *Pheucticus melanocephalus* (Black-headed Grosbeak)
- + *Guiraca caerulea* (Blue Grosbeak)
- 599+ *Passerina amoena* (Lazuli Bunting)
- 518 *Carpodacus cassinii* (Cassin Finch)
- 519+ *Carpodacus mexicanus* (House Finch)
- 529+ *Spinus tristis* (American Goldfinch)
- 530+ *Spinus psaltria* (Lesser Goldfinch)
- 587+ *Pipilo erythrophthalamus* (Rufous Sided Towhee)
- 591+ *Pipilo fuscus* (Brown Towhee)
- 542+ *Passerculus sandwichenis* (Savannah Sparrow)
- 546 *Ammodramus savannarum* (Grasshopper Sparrow)
- 552 *Chondestes grammacus* (Lark Sparrow)
- 580 *Aimophila ruficeps* (Rufus-crowned Sparrow)
- 574 *Amphispiza belli* (Sage Sparrow)
- 567+ *Junco hyemalis* (Dark-eyed Junco)
- 560 *Spizella passerina* (Chipping Sparrow)
- 562 *Spizella breweri* (Brewer's Sparrow)
- 554+ *Zonotrichia leucophrys* (White-crowned Sparrow)
- 585+ *Passerella iliaca* (Fox Sparrow)
- 581+ *Melospiza melodia* (Song Sparrow)

Family Ploceidae (Weaver Finches)
- + *Passer domesticus* (House Sparrow)

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* Fully protected species (State and/or Federal laws)

R Rare or endangered species (State and/or Federal laws)

a

b

\+ Species observed during the study.

TABLE 4.4.1. Checklist of Mammals in the Region of Vandenberg AFB.

Order Marsupialia
Family Didelphidae
+ *Didelphis marsupialis* (Common Opossum)

Order Insectivora
Family Soricidae
Notiosorex crawfordi (Gray Shrew)
+ *Sorex ornatus* (Ornate Shrew)
+ *Sorex trowbridgii* (Trowbridge's Shrew)
Family Talpidae
+ *Scapanus latimanus* (Broad-footed Mole)

Order Chiroptera
Family Vespertilionidae
Myotis yumanensis (Yuma Myotis)
Myotis thysanodes (Fringed Myotis)
Myotis evotis (Long-eared Myotis)
Myotis volans (Long-legged Myotis)
Myotis californicus (California Myotis)
Myotis subulatans (Small-footed Myotis)
Pipistrellus hesperus (Western Pipistrelle)
Eptesteus fuscus (Big Brown Bat)
Plecotus townsendi (Lump-nosed Bat)
Lasiurus borealis (Red Bat)
Lasiurus cinereus (Hoary Bat)
Corynorhinus townsendii (Townsend's Big-eared Bat)
Antrozous pallidus (Pallid Bat)
Family Molossidae
Tadarida brasilensis (Brazilian Free-tailed Bat)
Eumops perotis (Greater Mastiff Bat)

Order Lagomorpha
Family Leporidae
+* *Lepus californicus* (Black-tailed Jack Rabbit)
+* *Sylvilagus audubonii* (Desert Cottontail)
+* *Sylvilagus bachmani* (Brush Rabbit)

Order Rodentia
Family Sciuridae
Eutamias merriami (Merriam's Chipmunk)
+ *Spermorphilus (Citellus) beecheyi* (California Ground Squirrel)
+* *Sciurus griseus* (Western Gray Squirrel)
Family Geomyidae
+ *Thomomys umbrinus* (Southern Pocket Gopher)
Family Heteromyidae
+ *Perognathus californicus* (California Pocket Mouse)
+ 1) *Dipodomys heermanni* (Heermann's Kangaroo Rat)
1) *Dipodomys venustus* (Graceful Kangaroo Rat)
+ 1) *Dipodomys agilis* (Agile Kangaroo Rat)

Table 4.4.1. cont.

	Family Cricetidae	
·		*Onychomys torridus* (Southern Grasshopper Mouse)
+		*Reithrodontomys magalotis* (Western Harvest Mouse)
+		*Peromyscus californicus* (California Mouse)
+		*Peromyscus maniculatus* (Deer Mouse)
+		*Peromyscus boylii* (Brush Mouse)
+		*Peromyscus truei* (Piñon Mouse)
+		*Neotoma lepida* (Desert Wood Rat)
+		*Neotoma fuscipes* (Dusky-footed Wood Rat)
+		*Microtus californicus* (California Vole; Ca. Meadow Mouse)
	Family Castoridae	
+		*Castor canadensis* (Beaver)
	Family Muridae	
		Rattus rattus (Black Rat)
		Rattus norvegicus (Norway Rat)
		Mus musculus (House Mouse)
Order Carnivora		
	Family Canidae	
+		*Canis latrans* (Coyote)
+*		*Urocyon cinereoargenteus* (Gray Fox)
	Family Procyonidae	
**		*Bassariscus astutus* (Ringtailed Cat)
+*		*Procyon lotor* (Raccoon)
	Family Mustelidae	
+		*Mustela frenata* (Long-tailed Weasel)
+		*Taxidea taxus* (Badger)
		Spilogale gracilis (Western Spotted Skunk)
+		*Mephitis mephitis* (Striped Skunk)
	Family Felidae	
**		*Felix concolor* (Mountain Lion)
+*		*Lynx rufus* (Bobcat)
Order Artiodactyla		
	Family Cervidae	
+*		*Dama (Odocoileus) hemionus* (Mule Deer)
	Family Suidae	
+*		*Sus scrofa* (Feral Pig)

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* Species regulated by California Department of Fish and Game and California Fish and Game Commission.

** Fully protected species under current California law.

1) Thought by some mammalogists to be conspecifics (ref. 26).

\+ Species observed during the survey.

date by vegetational association, along with expected vegetational affinities, in Table 6.1.5 of Volume I. Section 4.5 includes a summary of relative abundance and diversity of mammals sampled in each major vegetation type.

A taxonomic problem seems to be evident in the genus *Dipodomys* (Kangaroo rats) in the vicinity of Vandenberg AFB. Three species are described from the vicinity: *D. agilis*, *D. venustus*, and *D. heermanni*. All three may be conspecific (ref. 25), and further investigation of series collected during the course of this project may aid in resolution of the systematic status of this group. Field identifications to date on live specimens indicate both *D. hermanni* and *D. agilis*; however, reliable identification can only be made from skulls and bacculi (or penis).

4.4.2. Large terrestrial mammals. Both Sherman and pitfall trapping techniques, designed for capture of amphibians, reptiles, and small mammals, are not applicable for large mammals such as bobcat, coyote, mule deer and feral pig. The occurrence of these species is based on sightings in the field by project personnel as well as competent Vandenberg AFB personnel.

This section of the report will be directed to large mammals observed on base during daily, routine field work commencing on July 30, 1974, and terminating on June 6, 1975. In most cases, numbers of observations, area observed, and specific vegetation types will be given in the following annotated list. In addition, evidence by scat, tracks, dens, or carcasses were employed to confirm the presence of large mammal species.

Black-tailed Jackrabbit: This species was observed in nearly every vegetation type. It was most abundant in stabilized dune and annual grassland vegetation on Burton Mesa. Although the Black-tailed Jackrabbit reproduces

year-round, their numbers are regulated by such predators as eagles, hawks, owls and snakes (including rattlesnake) (ref. 26).

Desert Cottontail: Also called the Audubon Cottontail, this species is perhaps (with the possible exception of the California Ground Squirrel) the most frequently seen large terrestrial mammal on base. It is found in nearly every vegetation type, with the exception of Tanbark Oak forest. Preferring somewhat low brush cover such as chaparral and coastal sage scrub, this species is only occasionally seen in the Sudden Ranch area. Coyote, fox, bobcat, hawks, and owls are known predators of the Desert Cottontail.

Brush Rabbit: Unlike the Desert Cottontail, the Brush Rabbit prefers extremely dense wooded and brush areas where it feeds in close proximity to its hiding place (ref. 26). This species was occasionally seen on Vandenberg AFB. Like most species of hares and rabbits of the southwest, the Brush Rabbit will breed year-round with three to six in a litter. Predators are the same as those for the Desert Cottontail.

Merriam Chipmunk: According to Ingles (ref. 26), this species frequents large stands of chaparral and foothill woodland and may extend up to 7,000 feet into open coniferous forests in the southern half of California. Merriam Chipmunk was not seen during the survey, although it is expected uncommonly in Bishop Pine forest, Oak Woodland, Tanbark Oak forest, and tall stands of dense chaparral.

California Ground Squirrel: This species is common throughout the year in disturbed areas on Vandenberg AFB. Sudden Ranch area has the largest on-base population of this squirrel, perhaps as a result of overgrazing and reduction of native chaparral and coastal sage scrub communities.

Western Gray Squirrel: Restricted to Bishop Pine forest, this species was occasionally seen off Santa Ynez Ridge Road and Lucio Road during spring and summer months. Currently, there are two individuals nesting in the burned pine forest at quadrat HB-457 (Appendix A).

Beaver: Introduced. Chiefly nocturnal in habits, the beaver was not observed at Vandenberg AFB. Three dams were seen on the San Antonio Creek in the vicinity of El Rancho Road bridge; five dams were present on the Santa Ynez River just west of the Federal Correctional Institution. According to Mr. Jim Johnston, California Department of Fish and Game was unsuccessful at introducing beaver in Honda Creek.

Coyote: This species has been seen abroad in every existing vegetation type during both day and night It was frequently seen in the cantonment area around buildings and foraging among eucalyptus trees. Few coyotes exist in the highly disturbed Sudden Ranch area due to the non-availability of food through habitat destruction.

Gray Fox: According to several airmen on base, the gray fox has occupied buildings and subsequently established dens in the cantonment area. Scats were seen in chaparral on south Vandenberg AFB, and one adult was observed crossing Santa Ynez Ridge Road and into low chaparral.

Ringtailed Cat: This secretive, nocturnal animal frequents caves, crevices, and hollow trees in thick brush and forested areas. Although not seen on the survey, this species is expected in Honda and Bear Creek Canyons. This is a fully protected species under California law.

Raccoon: Tracks were present in close proximity to permanent bodies of water, i.e. Honda Canyon, Bear Creek Canyon, Santa Ynez River, San Antonio Creek, and Mod III Lake. Several individuals were observed around the VOQ

during evening hours, and one was found dead on Point Sal Road north of Lions Head in August.

Long-tailed Weasel: This species was frequently seen on roads surrounded with annual grassland fields during April-September, particularly in the vicinity of the Santa Ynez River and also Burton Mesa along 13th Street. Few individuals were seen in fields within the cantonment area.

Badger: This species was not seen during the survey. It probably occurs uncommonly in open grassland, coastal sage scrub, and sparse chaparral vegetation.

Western Spotted Skunk: This small, nocturnal skunk favors chaparral and sparsely wooded areas and streamside conditions. It probably occurs uncommonly at Vandenberg AFB.

Striped Skunk: This species has been seen on numerous occasions throughout Vandenberg AFB. As many as six individuals per mile were counted on the Lompoc-Casimalia Highway with the roadside predominated by chaparral vegetation. One individual was seen on Espada Bluff, about 1/4 mile south of Sudden Ranch. This species has great importance in rodent and insect control.

Opossum: Introduced. One individual was found on the Santa Ynez River bridge. This species is usually active at night. Probably abundant in the Sudden Ranch area but also found in Oak Woodlands and riparian streamsides where they feed on insects, carrion and vegetable material.

Feral Cat: Introduced. These are domestic cats which have reverted to a wild state and have adapted to a diet of native reptiles, birds, and mammals. Several were seen in the cantonment area around buildings and open ruderal fields. One individual was observed fleeing from Oak Mountain Road down a storm drain and into dense chaparral on January 12, 1975.

Bobcat: Observations of bobcat on Vandenberg AFB include the following areas:

a) 19 August 1974, Bear Creek Canyon on Old Surf Road, Coastal Sage Scrub/Riparian Woodland; one individual, adult.

b) 22 August 1974, Honda Ridge Road, 1/4 mile east of Coast Road, Coastal Sage Scrub; one individual adult.

c) 17 October 1974, Bear Creek Canyon near quadrat WA-446, Riparian Woodland; six individuals (2 adults and 4 juveniles).

d) 12 October 1974, La Salle Canyon Road, Coastal Sage/Riparian Woodland; one individual, adult.

e) 12 October 1974, Honda Canyon Road, Riparian Woodland; one individual, adult.

f) 16 October 1974, near junction Honda Canyon and Coast Roads, Coastal Sage Scrub stabilized dune; one individual, adult.

g) 16 January 1975, Bear Creek Canyon, ca. 1/4 mile east of Old Surf Road, Riparian Woodland; one individual, adult.

h) 4 June 1975, 1.5 mile west of Tranquillon Peak on Honda Ridge Road, Chaparral/Coastal Sage Scrub; one individual, juvenile.

All observations of bobcat at Vandenberg AFB indicate a rather large population, particularly in canyons of riparian woodland.

Mountain Lion: This is the largest species of cat in California and is suffering rapid decline in numbers throughout its range. It seldom attacks livestock if deer are plentiful and there are only a few authentic cases of attacks on human beings (ref. 26). There have been sightings or evidence of mountain lion reported by military personnel in Bishop Pine forest and Purissima

Point, although these are questionable. No individuals, tracks or scat were discovered at Vandenberg AFB by field personnel.

Mule Deer. This species was seen on numerous occasions in every vegetation type at Vandenberg AFB. Population estimates of 2,500-3,000 were suggested for deer occurring on base (ref. 27), although this figure seems high based on availability of primary feeding areas. Accurate estimates are given in section 7.3, Volume I. Chaparral vegetation provides browse for mule deer as well as grassland bordering the Santa Ynez. *Ceanothus* sp. in drainages, canyons, and mesas is excellant browse for this species. Few deer were seen in the vicinity of Sudden Ranch. This could be the effects of 1) excessive off-base poaching, 2) competition with grazing livestock, and 3) destruction of primary feeding resources. Compton (ref. 27) discussed deer-aircraft collision hazards at Vandenberg AFB and suggests that an "...effective control of the problem is possible with a specially constructed fence and limited habitat alteration". Large herds (i.e., 20+) have been seen in chaparral land circling the airfield as well as on lawns within the cantonment area.

Feral Pig: Introduced. On Vandenberg AFB, it is most abundant in San Antonic Creek and associated Barka Slough. It has been observed in areas of dense Ripa:ian woodland or wetland scrub such as Bear Creek Canyon, Honda Creek, and the Santa Ynez River valley. Freshly broken turf, up-rooted plants and numerous tracks were evidence of feral pig activity along wetland areas throughout the base.

4.4.3. Bats. Bats are the only mammals of true flight. A total of 24 species occur in California, nearly all being insectivorus. Of this total, 14 species of bats are expected at Vandenberg AFB; none were seen during the entire survey. The absence of bats an Vandenberg AFB may be associated with

long periods of heavy fog and a reduction of flying insects. Furthermore, fog may impair their echolocation system, although this hypothesis needs to be substantiated. Several attempts were made to document the occurrence of bats on base. Bridges in the vicinity of Honda Canyon, old barns at Sudden Ranch, and the boat house were carefully searched during spring and winter months without success.

4.4.4. Marine mammals. Due to the close proximity of the 100 fathom contour curve to the Vandenberg shoreline, any normally occurring species of marine mammal may be found in this area. In addition, any north Pacific temperate, subtemperate or tropical species may move into this area with summer waters, and many more northerly forms may be found here in the winter months, (Table 4.4.4.1).

Order Cetacea

Suborder Odontoceti

Phocoena phocoena (Harbor Porpoise). The Harbor Porpoise ranges from Point Barrow, Alaska, south to central California in San Luis Obispo County. It occasionally occurs in waters off southern California with only one record in Los Angeles Harbor. One skull was discovered near the mouth of the San Antonio River in December, 1974. This species probably occurs uncommonly along the coast of Vandenberg AFB.

Suborder Mysticeti

Eschrichtius glaucus (California Gray Whale). During the period from December through May the gray whale is the most commonly observed marine mammal in the Vandenberg area. During the summer months gray whales feed in the western Bering Sea and adjacent Arctic Ocean. In the winter months

TABLE 4.4.4.1. List of Marine Mammal Species Occurring off Vandenberg AFB in Order of Probable Abundance.

Order Cetacea
- Suborder Odontoceti
  - Family Delphinidae
    - *Lagenorhynchus obliquidens* (Pacific White-sided Dolphin)
    - *Phocoenoides dalli* (Dall's Porpoise)
    - *Lissodelphis borealis* (Northern Right Whale Dolphin)
    - **Phocoena phocoena* (Harbor Porpoise)
    - *Orcinus orca* (Killer Whale)
- Suborder Mysticeti
  - **Eschrichtius glaucus* (Gray Whale)
  - *Balaenoptera acutorostrata* (Minke Whale)
  - *Megaptera novaeangliae* (Humpback Whale)
  - *Balaenoptera physalus* (Fin Whale)
  - *Balaenoptera borealis* (Sei Whale)

Order Carnivora
- Suborder Fissipedia
  - *Enhydra lutris nereis* (Southern Sea Otter)
- Suborder Pinnipedia
  - **Eumetrpias jabata* (Steller Sea Lion)
  - **Zalophus californianus* (California Sea Lion)
  - **Phoca vitulina* (Harbor Seal)

---

* Sightings reported during the present study.

between December and February, they follow the coastline to the breeding lagoons of Baja California in groups of two to five. The reverse or northward migration becomes heavy in early March and tapers off rapidly in early May (ref. 28). The contour of the coast has much to do with the proximity of the whales to shore and any promontory that lies across a bight or bay is used as a landmark point (ref. 28). They may approach from one mile to within a few hundred yards of shore and have been reported to surf ride breakers (ref. 29). In the Vandenberg area, Point Arguello seems to serve as just such a landmark point. Consequently, this brings the entire eastern Pacific grey whale population within the three-mile restricted zone in this area. At present the population has stabilized at about 10,000-12,000 individuals (ref. 28). This species of Cetacean is on the federal list of rare and endangered species. Numerous sightings close to shore at south Vandenberg were made.

Order Carnivora

Suborder Fissipedia

Enhydra lutris nereis (Southern Sea Otter). Although presently not documented in the Vandenberg area, the former range of the California sea otter extended from the Aleutian Islands to Baja California (ref. 30). Recently, the population in the area of Monterey, California, has been expanding rapidly, and its southern range has extended to include Point Buchon and Avila (ref. 30). Due to the presence of kelp and the relatively undisturbed rocky intertidal zone, the Vandenberg area presents an ideal sea otter habitat. Therefore, considering the restricted access of this stretch of shoreline, it is quite possible that the sea otter may have already established a colony in the northern area of the base. However, since sea otters can feed only in

rocky zones, this would imply a migration across a 20-mile stretch of sandy beach from Pismo Beach to Mussel Rock and Point Sal. This would hardly prove a serious barrier since sea otters have been known to migrate 30 miles or more (ref. 31). The 13 miles of coastline between Point Buchon and Pismo Beach should also not be a deterrent due to the presence of much ideal sea otter habitat. The total area which must be traveled is estimated at only 33 miles. It is logical to assume that this fully protected species, if not now present, will shortly be found in the Vandenberg area--barring the intervention of man.

Suborder Pinnipedia

Eumetopias jabata (Steller's Sea Lion). The range of the Steller sea lion includes the Channel Islands of the southern California coast northward to the Bering Sea (ref. 32). Rookeries are most often found in areas of remote rocky coasts well away from civilization. The breeding season begins early in May when the adult bulls establish their territories. Females arrive and give birth two to three weeks later and the bulls retain their territories until August. At this time the individual males are thought to migrate northward since fewer males are seen on the California coast during the winter (ref. 32). One dead adult male was found in December 1974 near San Antonio Lagoon.

Zalophus californianus (California Sea Lion). Much of the range of the California sea lion overlaps that of the Steller sea lion. They exist in almost equal numbers along the coast and also frequent remote, rocky shores. The breeding season extends from the month of May through June. Individuals have been observed from Point Arguello north to Lion's Head.

Phoca vitulina (Harbor Seal). The harbor seal is distributed along the Pacific coasts of North America south of the Aleutians to the coasts of California and Mexico (ref. 32). The southernmost limit of this species is most likely Cedros Island off Baja California. This species normally pups on land or on a sandbank with the first births occurring in April. Observations by the Naval Undersea Center, San Diego have confirmed breeding activity in the Vandenberg area (Leatherwood, per. comm.). Numerous adults utilize rocky shore areas from the boat house (south of Point Arguello) to Purissima Point for hauling grounds. As many as 69 in a group have been recorded.

4.5. Structure and Dynamics of Vertebrate Communities

In the following tables, the quantitative aspects of the vertebrate sampling programs described in Section 4.1 are summarized. Table 4.5.1 lists the abbreviations used in recording the occurrence of each vertebrate species in subsequent Tables 4.5.2 to 4.5.5. Table 4.5.2 describes the total capture frequencies of vertebrates taken in Sampling Period I (27 September to 19 October 1974), by vegetational association. Table 4.5.2 contains these data for Sampling Period II (5 Janaury to 29 January 1975). Tables 4.5.4 and 4.5.5 present these data for Sampling Periods III (21 March to 11 April 1975) and IV (12 May to 6 June 1975), respectively. These tables provide a summary of all the raw field data used in deriving the next set of tables, terrestrial vertebrate relative abundance (and diversity) summaries.

Table 4.5.6 contains the above described summaries of relative abundance and diversity for amphibians, reptiles and small mammals taken at permanent

stations, by time of year. Each vegetational unit is treated separately, and the sub-sections of Table 4.5.6 are as follows: 1 - Bishop pine forest, 2 - Tanoak forest, 3 - Oak Woodland, 4 - Riparian Woodland, 5 - Chaparral, 6 - Coastal Sagebrush (normal phase), 7 - Coastal Sagebrush (stabilized dune phase), 8 - Coastal Sagebrush (purple sage phase), 9 - Annual Grassland, 10 - Coastal Salt Marsh.

Estimates of avian relative abundance and diversity are compiled in Table 4.5.7, from permanent sampling quadrat transects and other areas. These data are presented by census season, by vegetational community or habitat type. The sub-units of Table 4.5.7 are as follows: 1 - Bishop Pine forest, 2 - Tanoak forest, 3 - Oak Woodland, 4 - Riparian Woodland, 5 - Chaparral, 6 - Coastal Sagebrush (all phases), 7 - Annual Grassland, 8 - Coastal Salt Marsh, 9 - Fresh Water Marshes and Lakes, 10 - Coastal Lagoons, and 11 - Coastal Strand.

Table 4.5.1.

Codes for Vertebrate Species Listed in

Tables 4.5.2 to 4.5.5.

Abbreviation	Species	Common Name
Ecs	Ensatina eschscholtzi	Ensatina
Bat	Batrachoc ps attenuatus	Slender Salamander
Alu	Aniedes lugubris	Arboreal Salamander
Hre	Hyla regilla	Pacific Tree Frog
Soc	Sceloporus occidentalis	Western Fence Lizard
Pco	Phrynosoma coronatum	Coast Horned Lizard
Esk	Eumeces skiltonianus	Western Skink
Gmu	Gerrhonotus multicarinatus	Southern Alligator Lizard
Dpu	Diadophis punctatus	Ringneck Snake
Pme	Pituophis melanoleucus	Gopher Snake
Tel	Thamnophis elegans	Western Terrestrial Garter Snake
Tsi	Thamnophis sirtalis	Western Aquatic Garter Snake
Cvi	Crotalus viridis	Pacific Rattlesnake
Sor	Sorex ornatus	Ornate Shrew
Str	Sorex trowbridgii	Trowbridge Shrew
Dhe	Dipodomys heermanni	Heerman's Kangaroo Rat
Dag	Dipodomys agilis	Agile Kangaroo Rat
Tum	Thommomys umbrinus	California Pocket Gopher
Pca	Perognathus californicus	California Pocket Mouse
Rme	Reithrodontomys megalotis	Western Harvest Mouse
Pcl	Peromyscus californicus	California Mouse
Pma	Peromyscus maniculatus	Deer Mouse
Ptr	Peromyscus truei	Pinyon Mouse
Pbo	Peromyscus boylei	Brush Mouse
Nfu	Neotoma fuscipes	Dusky-footed Woodrat
Nle	Neotoma lepida	Desert Woodrat
Mca	Microtus californicus	California Vole

Table 4.5.2 QUADRAT SAMPLING RESULTS BY VEGETATIONAL ASSOCIATION

Sampling Period I - 27 September - 19 October 1974

Includes all amphibians, reptiles, and small mammals removed from pitfall and Sherman traps; also includes marked and recaptured individuals.

		Vegetation Associations								
Species	#	*Coastal Salt Marsh	Stabilized Dunes	+Coastal Sage Scrub	Chaparral	Oak Woodland	Bishop Pine Forest	*Tanbark Oak Forest	Riparian Woodland	Annual Grassland
Ees	16	0	0	0	4	1	0	7	3	1
Bat	1	0	0	0	0	0	0	1	0	0
Alu	1	0	0	0	0	1	0	0	0	0
Hre	1	0	0	0	1	0	0	0	0	0
Soc	232	0	30	40	6	37	1	14	67	
Esk	8	0	0	3	0	2	0	1	2	0
Gmu	1	0	0	0	0	0	0	0	1	0
Dpu	1	0	0	0	0	1	0	0	0	0
Pme	7	0	0	4	1	0	0	0	0	2
Tel	3	0	2	0	1	0	0	0	0	0
Sor	29	0	9	11	4	1	0	1	1	2
Str	5	0	0	1	0	1	1	2	0	0
Sla	1	0	0	1	0	0	0	0	0	0
Dhe	1	0	0	1	0	0	0	0	0	0
Dag	20	0	7	0	3	4	2	0	0	4
Tum	9	0	0	5	0	3	0	0	0	1
Pca	33	0	6	7	6	0	0	2	1	11
Rme	38	13	5	5	0	1	2	0	2	10
Pcl	41	0	0	4	12	0	21	3	1	0
Pma	217	13	39	64	12	12	1	10	21	45
Mca	37	10	1	1	2	11	5	0	1	6
Nfu	19	0	0	1	4	2	2	1	9	0
Total Captures	724	36	99	148	90	46	71	29	56	149
# Species	22	3	8	14	12	13	8	10	11	10

+Based on six sampling quadrats
*Based on two sampling quadrats
all others, four sampling quadrats

Table 4.5.3. QUADRAT SAMPLING RESULTS BY VEGETATIONAL ASSOCIATION

Sampling Period II - 5 January - 29 January 1975

Includes all amphibians, reptiles, and small mammals removed from pitfall and Sherman traps; also includes marked and recaptured individuals.

		Vegetation Associations								
Species	#	*Coastal Salt Marsh	Stabilized Dunes	+Coastal Sage Scrub	Chaparral	Oak Woodland	Bishop Pine Forest	*Tanbark Oak Forest	Riparian Woodland	Annual Grassland
Ees	24	0	2	0	9	1	9	0	3	0
Bat	0	0	0	0	0	0	0	0	0	0
Alu	1	0	0	0	0	0	1	0	0	0
Hre	2	0	0	0	1	0	0	0	1	0
Soc	12	0	2	5	0	0	0	0	3	2
Esk	1	0	0	1	0	0	0	0	0	0
Gmu	0	0	0	0	0	0	0	0	0	0
Dpu	0	0	0	0	0	0	0	0	0	0
Pme	0	0	0	0	0	0	0	0	0	0
Tel	1	0	0	0	0	0	0	0	1	0
Sor	8	0	1	1	2	3	0	0	0	1
Str	12	0	0	0	1	0	2	1	8	0
Sla	0	0	0	0	0	0	0	0	0	0
Dhe	0	0	0	0	0	0	0	0	0	0
Dag	11	0	3	2	2	0	2	0	1	1
Tum	2	0	0	2	0	0	0	0	0	0
Pca	11	0	0	11	0	0	0	0	0	0
Rme	16	2	0	0	0	0	0	0	1	13
Pcl	44	0	0	12	5	9	14	1	3	0
Pma	250	36	63	54	16	16	6	14	17	28
Mca	17	0	2	4	1	1	4	0	4	1
Nfu	8	0	0	0	3	1	0	0	4	0
Total Captures	420	38	73	92	40	31	38	16	46	46
# spp	16	2	6	9	9	6	7	3	10	6

+Based on six sampling quadrats
*Based on two sampling quadrats - all others, four sampling quadrats
xIncludes supplemental Sherman trap data in absence of pitfalls

Table 4.5.4. QUADRAT SAMPLING RESULTS BY VEGETATIONAL ASSOCIATION

Sampling Period III - 21 March - 11 April 1975

Includes all amphibians, reptiles, and small mammals removed from pitfall and Sherman traps; also includes marked and recaptured individuals.

		Vegetation Associations								
Species	#	*Coastal Salt Marsh	Stabilized Dunes	+Coastal Sage Scrub	Chaparral	Oak Woodland	Bishop Pine Forest	*Tanbark Oak Forest	Riparian Woodland	Annual Grassland
Ees	26	0	1	0	9	0	8	6	2	0
Bat	0	0	0	0	0	0	0	0	0	0
Alu	6	0	1	2	2	0	1	0	0	0
Hre	2	0	0	1	0	0	1	0	0	0
Soc	127	0	31	22	16	5	16	0	16	21
Esk	6	0	0	2	0	1	0	0	1	2
Gmu	2	0	1	1	0	0	0	0	0	0
Dpu	0	0	0	0	0	0	0	0	0	0
Pme	1	0	0	0	0	0	0	0	0	1
Tel	4	0	0	0	1	0	0	0	3	0
Tsi	2	0	0	1	0	0	0	0	0	1
Sor	25	0	1	11	0	9	0	0	3	1
Str	63	0	2	1	0	2	4	10	44	0
Sla	0	0	0	0	0	0	0	0	0	0
Dhe	0	0	0	0	0	0	0	0	0	0
Dag	15	0	7	2	3	0	1	0	0	2
Tum	1	0	0	0	0	1	0	0	0	0
Pca	32	0	8	11	2	3	0	0	0	8
Rme	11	9	0	0	1	0	0	0	0	1
Pcl	77	0	0	6	11	9	27	12	12	0
Pma	251	11	43	55	29	28	10	8	48	19
Mca	22	1	1	8	6	0	1	0	4	1
Nfu	10	0	0	1	1	2	0	0	6	0
Ptr	6	0	0	0	0	4	2	0	0	0
Total Captures	689	21	96	124	81	64	71	36	139	57
# Species	20	3	10	14	11	10	10	4	10	10

+Based on six sampling quadrats
*Based on two sampling quadrats
all others, four sampling quadrats.

Table 4.5.5. QUADRAT SAMPLING RESULTS BY VEGETATIONAL ASSOCIATION

Sampling Period IV - 12 May to 6 June 1975

Includes all amphibians, reptiles, and small mammals removed from pitfall and Sherman traps; also includes marked and recaptured individuals.

		Vegetation Associations								
Species	#	*Coastal Salt Marsh	Stabilized Dunes	+Coastal Sage Scrub	Chaparral	Oak Woodland	Bishop Pine Forest	*Tanbark Oak Forest	Riparian Woodland	Annual Grassland
Ecs	9	0	1	1	0	0	1	6	0	0
Bat	0	0	0	0	0	0	0	0	0	0
Alu	2	0	1	0	1	0	0	0	0	0
Hre	1	0	0	0	1	0	0	0	0	0
Soc	159	0	15	31	30	5	28	2	21	27
Pco	1	0	0	0	0	1	0	0	0	0
Esk	15	0	0	9	0	0	0	0	0	6
Gmu	6	0	1	0	0	1	0	0	0	4
Dpu	1	0	0	0	0	0	0	1	0	0
Pme	8	0	0	3	2	0	1	1	0	1
Tel	14	0	0	0	1	1	2	0	8	2
Cvi	1	0	0	1	0	0	0	0	0	0
Sor	34	0	2	16	6	3	0	0	7	0
Str	207	9	19	14	23	16	28	37	60	1
Sla	0	0	0	0	0	0	0	0	0	0
Dhe	1	0	0	1	0	0	0	0	0	0
Dag	17	0	3	9	5	0	0	0	0	0
Tum	27	0	1	14	0	4	0	1	0	7
Pca	17	0	2	4	10	0	1	0	0	0
Rme	4	2	1	1	0	0	0	0	0	0
Pcl	66	0	2	5	16	8	20	9	6	0
Pma	143	11	34	33	4	7	6	4	30	14
Mca	33	3	1	7	2	10	0	2	4	4
Nfu	20	0	0	0	1	7	0	0	12	0
Nle	1	0	0	1	0	0	0	0	0	0
Ptr	4	0	0	0	0	2	2	0	0	0
Pbo	2	0	0	0	0	0	2	0	0	0
Total Captures	795	25	85	150	102	65	89	65	148	66
# Species	25	4	13	6	13	12	9	10	8	9

+Based on six sampling quadrats *Based on two sampling quadrats All others, four sampling quadrats

TABLE 4.5.6-1. Terrestrial Vertebrate Relative Abundance Summary, Bishop Pine Forest. Abundances expressed in catch per unit effor (#/1000 TN); sources - P = pitfall, S = Sherman, T = pitfall and Sherman; Simpson's diversity index (D_s) based on T. See text for calculation details for all entries.

Species Abundances	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T) (X + S.D.)
	P	S	T	P	S	T	P	S	T	P	S	T	
Amphibians													
Ensatina	--	--	--	9	--	9	8	--	8	1	--	1	4.5 ± 4.7
Arboreal Salamander	--	--	--	1	--	1	1	--	1	--	--	--	0.5
Pacific Tree Frog	--	--	--	--	--	--	1	--	1	--	--	--	0.3
Reptiles													
Western Fence Lizard	38	--	38	--	--	--	16	--	16	30	--	30	21 ± 16.7
Gopher Snake	--	--	--	--	--	--	--	--	--	1	--	1	0.3
Terrestrial Garter Snake	--	--	--	--	--	--	--	--	--	2	--	2	0.5
Mammals													
Trowbridge Shrew	1	--	1	2	--	2	4	--	4	30	--	30	9.3 ± 13.9
Agile Kangaroo Rat	--	50	50	--	50	50	--	25	25	--	--	--	31.3 ± 23.9
Western Harvest Mouse	2	--	2	--	--	--	--	--	--	--	--	--	0.5
California Mouse	2	475	477	--	350	350	7	500	507	1	600	601	483.8 ± 103.6
Deer Mouse	1	--	1	2	100	102	2	200	202	1	125	126	107.8 ± 83.0
Ducky-footed Woodrat	--	50	50	--	--	--	--	--	--	--	--	--	12.5 ± 25.0
California Vole	5	--	5	4	--	4	1	--	1	--	--	--	2.5 ± 2.4
Pinyon Mouse	--	--	--	--	--	--	1	25	26	--	50	50	19.0 ± 24.0
California Pocket Mouse	--	--	--	--	--	--	--	--	--	--	25	25	6.3 ± 12.5
Total Abundances	49	575	624	18	500	518	41	750	791	66	800	866	699.8 ± 157.8
Species Diversity Index	D_s = 1.63			D_s = 1.98			D_s = 2.0			D_s = 1.97			1.92 ± 0.20

TABLE 4.5.6-2. Terrestrial Vertebrate Relative Abundance Summary, Tanoak Forest. (See Table 4.5.6-1 for explanation.)

Species Abundances	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T)
	P	S	T	P	S	T	P	S	T	P	S	T	$\bar{X}$ + S.D.
Amphibians													
Ensatina	14	--	14	--	--	--	12	--	12	13	--	13	9.8 ± 6.6
Calif. Slender Salamander	2	--	2	--	--	--	--	--	--	--	--	--	0.5
Reptiles													
Western Fence Lizard	2	--	2	--	--	--	--	--	--	4	--	4	1.5 ± 1.9
Western Skink	2	--	2	--	--	--	--	--	--	--	--	--	0.5
Ring-necked Snake	--	--	--	--	--	--	--	--	--	2	--	2	0.5
Gopher Snake	--	--	--	--	--	--	--	--	--	2	--	2	0.5
Mammals													
Ornate Shrew	2	--	2	--	--	--	--	--	--	--	--	--	0.5
Trowbridge Shrew	4	--	4	2	--	2	20	--	20	79	--	79	26.3 ± 36.1
California Pocketmouse	--	100	100	--	--	--	--	--	--	--	--	--	25.0 ± 50.0
California Mouse	4	50	54	--	50	50	2	550	552	2	400	402	264.5 ± 252.9
Deer Mouse	--	500	500	8	500	508	--	400	400	--	200	200	402.0 ± 143.4
Dusky-footed Woodrat	--	50	50	--	--	--	--	--	--	--	--	--	12.5 ± 25.0
Southern Pocket Gopher	--	--	--	--	--	--	--	--	--	2	--	2	0.5
California Vole	--	--	--	--	--	--	--	--	--	4	--	4	1.0
Brush Mouse	--	--	--	--	--	--	--	--	--	--	100	100	25.0 ± 50.0
Total Abundances	30	700	730	10	550	560	34	950	984	108	700	808	770.5 ± 176.0
Species Diversity Index	D_S = 2.01			D_S = 1.20			D_S = 2.08			D_S = 3.00			2.07 ± 0.74

TABLE 4.5.6-3. Terrestrial Vertebrate Relative Abundance Summary, Oak Woodland. (See Table 4.5.6-1 for explanation.)

Species Abundances	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T) X + S.D.
	P	S	T	P	S	T	P	S	T	P	S	T	
Amphibians													
Ensatina	1	--	1	1	--	1	--	--	--	--	--	--	0.5
Arboreal Salamander	1	--	1	--	--	--	--	--	--	--	--	--	0.3
Reptiles													
Coast Horned Lizard	--	--	--	--	--	--	--	--	--	1	--	1	0.3
Western Fence Lizard	6	--	6	--	--	--	5	--	5	5	--	5	4.0 ± 2.7
Ringneck Snake	1	--	1	--	--	--	--	--	--	--	--	--	0.3
Southern Aligator Lizard	--	--	--	--	--	--	--	--	--	1	--	1	0.3
Terrestrial Garter Snake	--	--	--	--	--	--	--	--	--	1	--	1	0.3
Mammals													
California Pocket Mouse	--	--	--	--	--	--	3	--	3	--	--	--	0.8
Ornate Shrew	1	--	1	3	--	3	9	--	9	3	--	3	4.0 ± 3.5
Trowbridge Shrew	1	--	1	--	--	--	2	--	2	17	--	17	5.0 ± 8.4
Agile Kangaroo Rat	1	75	76	--	--	--	--	--	--	--	--	--	19.0 ± 38.0
Southern Pocket Gopher	3	--	3	--	--	--	1	--	1	4	--	4	2.0 ± 1.8
Western Harvest Mouse	1	--	1	--	--	--	--	--	--	--	--	--	0.3
California Mouse	--	--	--	--	225	225	3	150	153	6	50	56	108.5 ± 100.1
Deer Mouse	1	275	276	6	250	256	11	425	436	6	25	31	249.8 ± 166.6
Dusky-footed Woodrat	--	50	50	--	25	25	1	25	26	--	175	175	69.0 ± 71.6
California Vole	10	25	35	1	--	1	--	--	--	9	25	34	17.5 ± 19.6
Pinyon Mouse	--	--	--	--	--	--	--	100	100	1	25	26	31.5 ± 47.3
Total Abundances	29	425	454	11	500	511	36	700	736	54	300	354	513.8 ± 161.8
Species Diversity Index	D_S = 2.41			D_S = 2.22			D_S = 2.42			D_S = 3.42			2.62 ± 0.54

TABLE 4.5.6-4. Terrestrial Vertebrate Relative Abundance Summary, Riparian Woodland. (See Table 4.5.6-1 for explanation.)

Species Abundance	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T)
	P	S	T	P	S	T	P	S	T	P	S	T	X ± S.D.
Amphibians													
Ensatina	3	--	3	3	--	3	2	--	2	--	--	--	2.0 ± 1.4
Pacific Tree Frog	--	--	--	1	--	1	--	--	--	--	--	--	0.3
Reptiles													
Western Fence Lizard	14	--	14	3	--	3	16	--	16	22	--	22	13.8 ± 7.9
Western Skink	2	--	2	--	--	--	1	--	1	--	--	--	0.8
Southern Aligator Lizard	1	--	1	--	--	--	--	--	--	--	--	--	0.3
Terrestrial Garter Snake	--	--	--	1	--	1	3	--	3	8	--	8	3.0 ± 3.6
Mammals													
Ornate Shrew	1	--	1	--	--	--	3	--	3	7	--	7	2.8 ± 3.1
Trowbridge Shrew	--	--	--	8	--	8	44	--	44	64	--	64	29.0 ± 30.2
Agile Kangaroo Rat	--	--	--	--	25	25	--	--	--	--	--	--	6.3 ± 12.5
California Pocket Mouse	1	--	1	--	--	--	--	--	--	--	--	--	0.3
Western Harvest Mouse	2	--	2	1	--	1	--	--	--	--	--	--	0.8
California Mouse	--	25	25	--	75	75	8	125	133	2	100	102	83.8 ± 45.8
Deer Mouse	13	175	188	5	300	305	24	600	624	18	300	318	358.8 ± 186.3
Dusky-footed Woodrat	--	225	225	--	100	100	--	150	150	--	300	300	193.8 ± 87.5
California Vole	1	--	1	4	--	4	4	--	4	4	--	4	3.3 ± 1.5
Total Abundances	38	425	463	26	500	526	105	875	980	125	700	825	698.5 ± 245.3
Species Diversity Index	D_S = 2.46			D_S = 2.51			D_S = 2.23			D_S = 3.31			2.63 ± 0.47

TABLE 4.5.6-5. Terrestrial Vertebrate Relative Abundance Summary, Chaparral. (See Table 4.5.6-1 for explanation.)

Species Abundance	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T)
	P	S	T	P	S	T	P	S	T	P	S	T	$\bar{X}$ + S.D.
Amphibians													
Ensatina	4	--	4	9	--	9	9	--	9	--	--	--	5.5 ± 4.4
Pacific Tree Frog	1	--	1	1	--	1	--	--	--	1	--	1	0.8
Arboreal Salamander	--	--	--	--	--	--	2	--	2	1	--	1	0.8
Reptiles													
Western Fence Lizard	40	--	40	--	--	--	16	--	16	32	--	32	22.0 ± 17.7
Gopher Snake	1	--	1	--	--	--	--	--	--	2	--	2	0.8
Terrestrial Garter Snake	1	--	1	--	--	--	1	--	1	1	--	1	0.8
Mammals													
Ornate Shrew	4	--	4	2	--	2	--	--	--	6	--	6	3.0 ± 2.6
Trowbridge Shrew	--	--	--	1	--	1	--	--	--	25	--	25	6.5 ± 12.3
Agile Kangaroo Rat	--	75	75	--	50	50	--	75	75	--	125	125	81.3 ± 31.5
California Pocket Mouse	3	75	78	--	--	--	--	50	50	1	225	226	88.5 ± 97.2
California Mouse	--	300	300	--	125	125	1	250	251	2	350	352	257.0 ± 97.2
Deer Mouse	4	200	204	2	350	352	9	500	509	--	100	100	291.3 ± 178.2
Dusky-footed Woodrat	--	100	100	--	75	75	--	25	25	--	25	25	56.3 ± 37.5
California Vole	1	25	26	1	--	1	5	25	30	--	--	--	14.3 ± 16.0
Western Harvest Mouse	--	--	--	--	--	--	1	--	1	--	--	--	0.3
Total Abundance	59	775	834	16	600	616	44	925	969	71	825	896	828.8 ± 152.2
Species Diversity Index	D_S = 4.49			D_S = 2.85			D_S = 2.83			D_S = 3.97			3.54± 0.83

TABLE 4.5.6-6. Terrestrial Vertebrate Relative Abundance Summary, Coastal Sagebrush - Normal Phase. (See Table 4.5.6-1 for explanation.)

Species Abundance	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T)
	P	S	T	P	S	T	P	S	T	P	S	T	$\bar{X}$ + S.D.
Amphibians													
Arboreal Salamander	--	--	--	--	--	--	2	--	2	--	--	--	0.5
Reptiles													
Western Fence Lizard	11	--	11	1	--	1	9	--	9	9	--	9	7.5 ± 4.4
Southern Aligator Lizard	--	--	--	--	--	--	1	--	1	--	--	--	0.3
Gopher Snake	4	--	4	--	--	--	--	--	--	1	--	1	1.3 ± 1.9
Mammals													
Ornate Shrew	9	--	9	--	--	--	11	--	11	11	--	11	7.8 ± 5.3
Trowbridge Shrew	1	--	1	--	--	--	--	--	--	16	--	16	4.3 ± 7.9
Heermann's Kangaroo Rat	1	--	1	--	--	--	--	--	--	1	--	1	0.5
Agile Kangaroo Rat	--	--	--	--	67	67	1	--	1	3	133	136	51.0 ± 64.8
California Pocket Mouse	2	33	35	1	--	1	1	33	34	1	--	1	17.8 ± 19.4
Southern Pocket Gopher	1	--	1	1	--	1	--	--	--	3	--	3	13. ± 1.3
California Mouse	--	--	--	--	300	300	--	--	--	1	67	68	92.0 ± 142.3
Deer Mouse	15	800	815	19	233	252	17	661	678	7	233	240	496.3 ± 294.4
California Vole	--	33	33	--	--	--	6	33	39	1	--	1	18.3 ± 20.7
Western Harvest Mouse	1	--	1	--	--	--	--	--	--	1	--	1	0.5
Total Abundance	45	866	911	22	600	622	48	727	775	55	433	488	699.0 ± 183.6
Species Diversity Index	D_s = 1.25			D_s = 2.45			D_s = 1.30			D_s = 2.94			1.99 ± 0.84

TABLE 4.5.6-7. Terrestrial Vertebrate Relative Abundance Summary, Coastal Sagebrush - Stabilized Dune Phase. (See Table 4.5.6-1 for explanation.)

Species Abundance	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T)
	P	S	T	P	S	T	P	S	T	P	S	T	X + S.D.
Amphibians													
Ensatina	--	--	--	2	--	2	1	--	1	1	--	1	0.8
Arboreal Salamander	--	--	--	--	--	--	1	--	1	1	--	1	0.5
Reptiles													
Western Fence Lizard	30	--	30	2	--	2	31	--	31	16	--	16	19.8 ± 13.7
Terrestrial Garter Snake	2	--	2	--	--	--	--	--	--	--	--	--	0.5
Southern Aligator Lizard	--	--	--	--	--	--	1	--	1	1	--	1	0.5
Mammals													
Trowbridge Shrew	--	--	--	--	--	--	2	--	2	20	--	20	5.5 ± 9.7
Ornate Shrew	9	--	9	1	--	1	1	--	1	2	--	2	3.3 ± 3.9
Agile Kangaroo Rat	1	150	151	--	75	75	2	125	127	1	50	51	101.0 ± 46.0
California Pocket Mouse	3	75	78	--	--	--	7	25	32	2	--	2	28.0 ± 36.4
Western Harvest Mouse	5	--	5	--	--	--	--	--	--	1	--	1	1.5 ± 2.4
Deer Mouse	11	700	711	31	800	831	15	700	715	10	625	635	723.0 ± 80.9
California Vole	1	--	1	2	--	2	1	--	1	1	--	1	1.3 ± 0.5
Southern Pocket Gopher	--	--	--	--	--	--	--	--	--	1	--	1	0.3
California Mouse	--	--	--	--	--	--	--	--	--	--	50	50	12.5 ± 25.0
Total Abundance	62	925	987	38	875	913	62	850	912	57	725	782	898.5 ± 85.2
Species Diversity Index	D_s = 1.82			D_s = 1.20			D_s = 1.57			D_s = 1.50			1.52± 0.26

TABLE 4.5.6-8. Terrestrial Vertebrate Relative Abundance Summary, Coastal Sagebrush - Purple Sage Phase. (See Table 4.5.6-1 for explanation.)

Species Abundance	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T)
	P	S	T	P	S	T	P	S	T	P	S	T	$\bar{X}$ + S.D.
Amphibians													
Pacific Tree Frog	--	--	--	--	--	--	1	--	1	--	--	--	0.3
Ensatina	--	--	--	--	--	--	--	--	--	1	--	1	0.3
Reptiles													
Western Fence Lizard	42	--	42	5	--	5	20	--	20	36	--	36	25.8 ± 16.7
Western Skink	4	--	4	1	--	1	3	--	3	13	--	13	5.3 ± 5.3
Gopher Snake	1	--	1	--	--	--	--	--	--	3	--	3	1.0
Common Garter Snake	--	--	--	--	--	--	1	--	1	--	--	--	0.3
Pacific Rattlesnake	--	--	--	--	--	--	--	--	--	1	--	1	0.3
Mammals													
Trowbridge Shrew	--	--	--	--	--	--	1	--	1	4	--	4	1.3 ± 2.0
Ornate Shrew	5	--	5	1	--	1	4	--	4	11	--	11	5.3 ± 4.2
Broad-footed Mole	1	--	1	--	--	--	--	--	--	--	--	--	0.3
Southern Pocket Gopher	5	--	5	1	--	1	--	--	--	17	--	17	5.8 ± 7.8
California Pocket Mouse	1	100	101	6	133	139	2	233	235	1	67	68	135.8 ± 72.3
Western Harvest Mouse	5	--	5	--	--	--	--	--	--	--	--	--	1.3 ± 2.5
California Mouse	--	133	133	--	100	100	2	133	135	--	67	67	108.8 ± 32.1
Deer Mouse	6	633	639	11	599	610	6	400	406	11	433	444	524.8 ± 116.8
Dusky-footed Woodrat	--	33	33	--	--	--	--	33	33	--	--	--	16.5 ± 19.1
California Vole	--	--	--	4	--	4	1	--	1	9	--	9	3.5 ± 4.0
Agile Kangaroo Rat	--	--	--	--	--	--	--	--	--	3	33	36	9.0 ± 18.0
Total Abundance	70	899	969	29	832	861	41	799	841	109	600	709	845.0 ± 106.7
Species Diversity Index	D_s = 2.14			D_s = 1.85			D_s = 2.95			D_s = 2.40			2.34 ± 0.47

TABLE 4.5.6-9. Terrestrial Vertebrate Relative Abundance Summary, Annual Grassland (including ruderal areas). (See Table 4.5.6-1 for explanation.)

Species Abundance	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T)
	P	S	T	P	S	T	P	S	T	P	S	T	$\bar{X}$ + S.D
Amphibians													
Ensatina	1	--	1	--	--	--	--	--	--	--	--	--	0.3
Reptiles													
Southern Aligator Lizard	--	--	--	--	--	--	--	--	--	4	--	4	1.0
Western Fence Lizard	67	--	67	2	--	2	21	--	21	29	--	29	29.8 ± 27.3
Gopher Snake	2	--	2	--	--	--	1	--	1	1	--	1	1.0 ± 0.8
Western Skink	--	--	--	--	--	--	2	--	2	6	--	6	2.0 ± 2.8
Common Garter Snake	--	--	--	--	--	--	1	--	1	--	--	--	0.3
Western Garter Snake	--	--	--	--	--	--	--	--	--	2	--	2	0.5
Mammals													
Ornate Shrew	2	--	2	1	--	1	1	--	1	--	--	--	1.0 ± 0.8
Agile Kangaroo Rat	2	50	52	--	25	25	--	50	50	--	--	--	31.8 ± 24.5
California Pocket Mouse	6	125	131	--	--	--	6	50	56	--	--	--	46.8 ± 62.1
Southern Pocket Gopher	1	--	1	--	--	--	--	--	--	7	--	7	2.0 ± 3.4
Western Harvest Mouse	10	00	10	12	25	37	1	--	1	--	--	--	12.0 ± 17.3
Deer Mouse	28	425	453	12	400	412	6	325	331	6	200	206	350.5 ± 108.9
California Vole	6	--	6	1	--	1	1	--	1	4	--	4	3.0 ± 2.5
Trowbridge Shrew	--	--	--	--	--	--	--	--	--	1	--	1	0.3
Total Abundance	125	600	725	28	450	478	40	425	465	60	200	260	482.0 ± 190.3
Species Diversity Index	D_S = 2.29			D_S = 1.33			D_S = 1.87			D_S = 1.56			1.76± 0.42

TABLE 4.5.6-10. Terrestrial Vertebrate Relative Abundance Summary, Coastal Salt Marsh. (See Table 4.5.6-1 for explanation.)

Species Abundance	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter			Year Ave. (T)
	P	S	T	P	S	T	P	S	T	P	S	T	$\bar{X}$ + S.D.
Amphibians				*						+			
Reptiles				*									
Mammals													
Western Harvest Mouse	13	--	13	*	18	18	8	26	34	4	25	29	23.5 ± 9.7
Deer Mouse	6	175	181		322	322	--	289	289	9	225	234	256.5 ± 62.1
California Vole	8	50	58		--	--	--	26	26	4	50	54	34.5 ± 27.1
Trowbridge Shrew	--	--	--		--	--	--	--	--	38	--	38	9.5 ± 19.0
Total Abundance	27	225	252	*	340	340	8	341	349	55	300	355	324.0 ± 48.4
Species Diversity Index	D_s = 1.76			D_s = 1.11			D_s = 1.43			D_s = 2.11			1.60 ± 0.43

* Pitfall traps inoperative due to winter tidal flooding; mammal estimates based on 112 trap days

\+ only one quadrat sampling station in operation

TABLE 4.5.7-1. Avian Relative Abundance Summary, Bishop Pine Forest. n = total number observed; #/man-hr = total number ÷ number of transects x .25 hr/transect; species diversity index = Simpson's D_s. See text for details.

Species	Autumn		Winter		Spring		Year Ave.
	n	#/m-hr	n	#/m-hr	n	#/m-hr	$\bar{X} \pm$ SD (#/m-hr)
California Valley Quail	32	43	--	--	--	--	14.3
Lazuli Bunting	1	1	--	--	--	--	0.3
Wrentit	25	33	37	37	11	11	27.0 ± 14.0
Rufous-sided Towhee	21	28	1	1	4	4	11.0 ± 14.8
Common Flicker	3	4	--	--	2	2	2.0
White-corwned Sparrow	19	25	4	4	--	--	9.7
Red-tailed Hawk	3	4	--	--	--	--	1.3
Mourning Dove	1	1	--	--	--	--	0.3
Scrub Jay	12	16	--	--	4	4	6.7
Dark-eyed Junco	20	27	--	--	3	3	10.0
Turkey Vulture	1	1	--	--	--	--	0.3
California Thrasher	3	4	--	--	2	2	2.0
Hermit Thrush	1	1	--	--	--	--	0.3
Black-tailed Gnat Catcher	1	1	--	--	--	--	0.3
House Finch	6	8	--	--	--	--	2.7
Western Flycatcher	1	1	--	--	--	--	0.3
Wilson's Warbler	2	3	--	--	--	--	1.0
American Goldfinch	1	1	--	--	--	--	0.3
Lesser Goldfinch	12	16	--	--	--	--	5.3
Red-breasted Nuthatch	1	1	--	--	--	--	0.3
Swainson's Thrush	1	1	--	--	--	--	0.3
Hutton's Vireo	1	1	--	--	--	--	0.3
Bewick's Wren	--	--	11	11	1	1	4.0
Ruby-crowned Kinglet	--	--	3	3	--	--	1.0
Yellow-rumped Warbler	--	--	2	2	--	--	0.7
Fox Sparrow	--	--	2	2	--	--	0.7
Bush-tit	--	--	--	--	2	2	0.7
Anna's Humingbird	--	--	--	--	4	4	1.3
Total Relative Abundance	168	221	60	60	33	33	104.7 ± 102
Species Diversity Index	D_s = 8.84		D_s = 2.42		D_s = 6.68		5.98 ± 3.27

Ave/spp = 3.73 ± 6.0

TABLE 4.5.7-2. Avian Relative Abundance Summary, Tanoak Forest. (See Table 4.5.7-1 for explanation.)

Species	Autumn n	Autumn #/m-hr	Winter n	Winter #/m-hr	Spring n	Spring #/m-hr	Year Ave. $\bar{X} \pm$ SD (#/m-hr)
Western Fly Catcher	15	30	--	--	--	--	10.0
Red-breasted Nuthatch	1	2	--	--	--	--	0.7
Dark-eyed Junco	45	90	--	--	1	2	30.7
Wrentit	2	4	--	--	--	--	1.3
White-crowned Sparrow	8	16	--	--	--	--	5.3
Tree Swallow	30	60	--	--	--	--	20.0
Common Flicker	14	28	--	--	--	--	9.3
Rufous-sided Towhee	2	4	--	--	--	--	1.3
Scrub Jay	7	14	1	2	--	--	5.3
Plain Titmouse	2	4	--	--	--	--	1.3
Western Bluebird	5	10	--	--	--	--	3.3
Black-throated Grey Warbler	2	4	--	--	--	--	1.3
Mourning Dove	12	24	--	--	--	--	8.0
Bewick's Wren	5	10	--	--	1	2	4.0
Acorn Woodpecker	2	4	--	--	--	--	1.3
Brown Towhee	3	6	--	--	--	--	2.0
House Wren	1	2	--	--	--	--	0.7
Bushtit	--	--	--	--	5	10	3.3
Anna's Hummingbird	--	--	--	--	2	4	1.3
Total Relative Abundance	156	312	1	2	9	18	110.7 $\pm$ 175
Species Diversity Index		D_s = 6.77		D_s = 0.0		D_s = 2.89	3.22 $\pm$ 3.40

Ave/spp = 5.81 $\pm$ 7.68

TABLE 4.5.7-3. Avian Relative Abundance Summary, Oak Woodland. (See Table 4.5.7-1 for explanation.)

Species	Autumn n	Autumn #/m-hr	Winter n	Winter #/m-hr	Spring n	Spring #/m-hr	Year Ave. $\bar{X} \pm SD$ (#/m-hr)
Brown Towhee	2	4	1	2	5	10	5.3 ± 4.2
Rufous-sided Towhee	4	8	3	6	5	10	8.0 ± 2.0
Bushtit	18	36	--	--	7	14	16.7
Wilson's Warbler	6	12	--	--	1	2	4.7
Dark-eyed Junco	5	10	--	--	5	10	6.7
House Finch	16	32	--	--	--	--	10.7
Red-tailed Hawk	5	10	--	--	--	--	3.3
House Wren	1	2	--	--	--	--	0.7
Lazuli Bunting	1	2	--	--	--	--	0.7
Scrub Jay	8	16	3	6	1	2	8.0 ± 7.2
Common Flicker	3	6	1	2	--	--	2 7
Yellow Warbler	2	4	--	--	--	--	1.3
Lesser Goldfinch	23	46	--	--	--	--	15.3
Wrentit	11	22	4	8	--	--	10.0
California Valley Quail	10	20	2	4	--	--	8.0
Downy Woodpecker	1	2	--	--	1	2	1.3
Traill's Flycatcher	3	6	--	--	--	--	2.0
Great Horned Owl	2	4	--	--	--	--	1.3
Swainson's Thrush	1	2	--	--	--	--	1.3
California Thrasher	1	2	--	--	1	2	1.3
Song Sparrow	4	8	--	--	--	--	2.7
Chestnut-backed Chickadee	4	8	--	--	--	--	2.7
Plain Titmouse	5	10	5	10	11	22	14.0 ± 6.93
Bewick's Wren	6	12	6	12	4	8	10.7 ± 2.31
Hermit Thrush	--	--	1	2	--	--	1.3
Ruby-crowned Kinglet	--	--	5	10	5	10	6.7
Hutton's Vireo	--	--	1	2	--	--	1.3
Golden-crowned Sparrow	--	--	1	2	--	--	1.3
Anna's Hummingbird	--	--	--	--	7	14	4.7
Western Glycatcher	--	--	--	--	7	14	4.7
Western Bluebird	--	--	--	--	2	4	1.3
White-crowned Sparrow	--	--	--	--	3	6	2.0
Total Relative Abundance	142	284	33	66	65	130	160.0 ± 112
Species Diversity Index	D_s = 12.93		D_s = 9.53		D_s = 11.38		11.28 ± 1.70

Ave/spp = 5.08 ± 4.56

TABLE 4.5.7-4. Avian Relative Abundance Summary, Riparian Woodland. (See Table 4.5.7-1 for explanation.)

Species	Autumn n	Autumn #/m-hr	Winter n	Winter #/m-hr	Spring n	Spring #/m-hr	Year Ave. $\bar{X} \pm SD$ (#/m-hr)
Bushtit	70	70	--	--	--	--	23.3
Red-tailed Hawk	7	7	--	--	--	--	2.3
Wren-tit	47	47	2	2	--	--	16.3
Brown Towhee	15	15	3	3	--	--	6.0
Bewick's Wren	2	2	8	8	25	25	117. ± 11.9
Rufous-sided Towhee	13	13	1	1	3	3	5.7 ± 6.4
Common Flicker	1	1	--	--	--	--	0.3
House Wren	2	2	--	--	--	--	1.3
Song Sparrow	54	54	--	--	14	14	22.7
Lewwer Goldfinch	19	19	--	--	--	--	6.3
Western Flycatcher	5	5	--	--	1	1	2.0
Yellowthroat	16	16	--	--	1	1	5.7
Nuttall's Woodpecker	2	2	--	--	--	--	1.3
Blue-grey Gnatchatcher	2	2	--	--	--	--	1.3
Allen's Hummingbird	4	4	--	--	1	1	1.7
Black Phoebe	5	5	--	--	--	--	1.7
Killdeer	8	8	--	--	--	--	2.7
House Finch	124	124	--	--	--	--	41.3
Cliff Swallow	50	50	--	--	--	--	16.7
Belted Kingfisher	1	1	--	--	--	--	0.3
Mourning Dove	30	30	--	--	--	--	10.0
Marsh Hawk	2	2	--	--	--	--	1.3
Crow	9	9	--	--	--	--	3.0
Roughwinged Swallow	9	9	--	--	--	--	3.0
Great Horned Owl	4	4	--	--	--	--	1.3
Wilson's Warbler	13	13	--	--	5	5	6.0
California Thrasher	1	1	--	--	--	--	0.3
Tree Swallow	8	8	--	--	--	--	2.7
Yellow Warbler	2	2	--	--	--	--	1.3
Loggerhead Shrike	1	1	--	--	--	--	0.3
Downy Woodpecker	2	2	1	1	2	2	1.7 ± 5.8
White-tailed Kite	10	10	--	--	--	--	3.3
Turkey Vulture	3	3	--	--	1	1	1.3
Cooper's Hawk	1	1	--	--	--	--	0.3
Black-headed Grosbeak	8	8	--	--	--	--	2.7
California Valley Quail	65	65	--	--	--	--	21.7
Hutton's Vireo	1	1	--	--	--	--	0.3
Anna's Hummingbird	1	1	--	--	3	3	1.3
Mockingbird	--	--	1	1	--	--	0.3
Hermit Thrush	--	--	3	3	--	--	1.0
Ruby-crowned Kinglet	--	--	17	17	--	--	5.7
Yellow-Rumped Warbler	--	--	48	48	7	7	18.3
Dark-eyed Junco	--	--	2	2	--	--	1.3
Golden-crowned Sparrow	--	--	1	1	--	--	0.3
Orange-crowned Warbler	--	--	--	--	1	1	0.3
Western Wood Pewee	--	--	--	--	2	2	0.7
Total Relative Abundance	617	617	87	87	66	66	256.7 ± 312
Species Diversity Index	D_s = 11.11		D_s = 2.88		D_s = 4.99		6.33 ± 4.27

Ave/spp = 5.67 ± 8.40

TABLE 4.5.7-5. Avian Relative Abundance Summary, Chaparral. (See Table 4.5.7-1 for explanation.)

Species	Autumn n	Autumn #/m-hr	Winter n	Winter #/m-hr	Spring n	Spring #/m-hr	Year Ave. $\bar{X} \pm$ SD (#/m-hr)
Scrub Jay	6	6	--	--	--	--	2.0
Mocking Bird	3	3	--	--	--	--	1.0
Wrentit	34	34	13	13	18	18	21.7 ± 11.0
Bushtit	22	22	--	--	4	4	8.7
California Valley Quail	51	51	16	16	2	2	23.0 ± 25.2
Bewick's Wren	2	2	--	--	--	--	1.3
Loggerhead Shrike	2	2	--	--	--	--	1.3
Black-headed Grosbeak	2	2	--	--	--	--	1.3
Western Flycatcher	5	5	--	--	--	--	1.7
Mourning Dove	30	30	--	--	--	--	10.0
Rufous-sided Towhee	12	12	2	2	6	6	6.7 ± 5.0
Western Bluebird	4	4	--	--	--	--	1.3
Lazuli Bunting	10	10	--	--	--	--	3.3
Poorwill	1	1	--	--	--	--	0.3
Say's Phoebe	1	1	--	--	--	--	0.3
Lark Sparrow	15	15	--	--	--	--	5.0
Cooper's Hawk	1	1	--	--	--	--	0.3
Plain Titmouse	1	1	--	--	--	--	0.3
Lesser Goldfinch	1	1	--	--	--	--	0.3
Dark-eyed Junco	4	4	--	--	--	--	1.3
Brown Towhee	62	62	--	--	--	--	20.7
Turkey Vulture	3	3	--	--	--	--	1.0
California Thrasher	4	4	--	--	4	4	2.7
Starling	300	300	--	--	--	--	100
Great Horned Owl	3	3	--	--	--	--	1.0
Red-tailed Hawk	7	7	--	--	--	--	2.3
Sharp-shinned Hawk	1	1	--	--	--	--	0.3
White-crowned Sparrow	9	9	--	--	1	1	3.3
Barn Owl	2	2	--	--	--	--	0.7
Common Flicker	6	6	--	--	--	--	2.0
Wilson's Warbler	5	5	--	--	--	--	1.7
Scrub Jay	--	--	1	1	1	1	1.3
Anna's Hummingbird	--	--	21	21	1	1	7.3
Fox Sparrow	--	--	--	--	3	3	1.0
Song Sparrow	--	--	--	--	5	5	1.7
Total Relative Abundance	609	609	53	53	45	45	235.7 ± 323
Species Diversity Index	*D_s = 10.35		D_s = 3.37		D_s = 5.10		6.27± 3.63

Ave/spp = 6.80 ± 17.3

* without starlings, D_s = 7.34 with starlings

TABLE 4.5.7-6. Avian Relative Abundance Summary, Coastal Sage (all phases combined). (See Table 4.5.7-1 for explanation.)

Species	Autumn n	Autumn #/m-hr	Winter n	Winter #/m-hr	Spring n	Spring #/m-hr	Year Ave. $\bar{X} \pm$ SD (#/m-hr)
California Thrasher	7	6	4	2	8	4	4.0 ± 2.0
Brown Thrasher	48	38	6	3	8	4	15.0 ± 19.9
Brewer's Blackbird	2	2	--	--	--	--	0.7
Cliff Swallow	60	48	--	--	--	--	2.7
Wrentit	19	15	15	6	26	14	11.7 ± 4.93
Marsh Hawk	6	5	--	--	--	--	1.7
Loggerhead Shrike	7	6	1	1	2	2	3.0 ± 2.65
California Valley Quail	84	67	4	2	18	9	26.0 ± 35.7
Purple Finch	11	9	--	--	--	--	3.0
Black Phoebe	1	1	--	--	--	--	0.3
American Kestrel	17	14	--	--	--	--	4.7
Bushtit	58	46	40	16	11	6	22.7 ± 20.8
Red-tailed Hawk	24	19	1	1	1	1	7.0 ± 10.4
Scrub Jay	7	6	--	--	1	1	2.0
Common Flicker	1	1	--	--	--	--	0.3
Roadrunner	2	2	--	--	1	1	0.7
Rufous-sided Towhee	5	4	2	1	19	9	
White-crowned Sparrow	18	14	12	5	34	19	12.7 ± 7.1
Bewick's Wren	2	2	--	--	12	7	3.0
Turkey Vulture	7	6	--	--	--	--	3.0
Sharp-shinned Hawk	1	1	--	--	--	--	0.3
Crow	10	8	--	--	--	--	2.7
Western Flycatcher	15	12	--	--	--	--	4.0
Black-headed Grosbeak	3	2	--	--	--	--	0.7
Black-chinned Hummingbird	2	2	--	--	--	--	0.7
Allen's Hummingbird	2	2	--	--	--	--	0.7
Belted Kingfisher	1	1	--	--	--	--	0.3
Western Bluebird	1	1	--	--	--	--	0.3
Rube-crowned Kinglet	1	1	3	2	--	--	1.0
Great Horned Owl	1	1	--	--	--	--	0.3
Golden-crowned Sparrow	--	--	12	5	47	23	9.3
Black-tailed Gnatcatcher	--	--	1	1	--	--	0.3
House Finch	--	--	--	--	8	4	1.3
Western Meadowlark	--	--	--	--	1	1	0.3
Cooper's Hawk	--	--	--	--	1	1	0.3
Anna's Hummingbird	--	--	--	--	1	1	0.3
Total Relative Abundance	423	342	101	45	199	107	164.7 ± 157
Species Diversity Index	D_s = 10.15		D_s = 6.78		D_s = 8.83		8.59 ± 1.70

Ave/spp = 4.05 ± 5.86

TABLE 4.5.7-7. Avian Relative Abundance Summary, Annual Grassland. (See Table 4.5.7-1 for explanation.)

Species	Autumn n	Autumn #/m-hr	Winter n	Winter #/m-hr	Spring n	Spring #/m-hr	Year Ave. $\bar{X} \pm SD$ (#/m-hr)
Red-tailed Hawk	33	33	5	5	1	1	13.0 ± 17.4
Loggerhead Shrike	17	17	--	--	--	--	5.7
Roadrunner	8	8	--	--	--	--	2.7
Red-winged Blackbird	501	501	--	--	--	--	167
American Kestrel	7	7	--	--	--	--	2.3
Western Meadowlark	24	24	1	1	11	11	12.0 ± 11.5
Mourning Dove	80	80	--	--	--	--	26.7
Brown Towhee	6	6	1	1	--	--	2.3
California Thrasher	2	2	--	--	--	--	0.7
Rock Dove	30	30	--	--	--	--	10.0
Red-shouldered Hawk	3	3	--	--	--	--	1.0
Brown-headed Cowbird	10	10	--	--	--	--	3.3
California Valley Quail	137	137	--	--	--	--	45.7
House Finch	65	65	18	18	5	5	29.3 ± 31.6
Golden Eagle	2	2	--	--	--	--	0.7
Barn Owl	2	2	--	--	--	--	0.7
Allen's Hummingbird	1	1	--	--	--	--	0.3
Lesser Goldfinch	72	72	--	--	--	--	24
House Finch	93	93	--	--	--	--	31
Sharp-shinned Hawk	1	1	--	--	--	--	0.3
Black-headed Grosbeak	3	3	--	--	--	--	1.0
Bewick's Wren	2	2	--	--	4	4	2.0
Western Wood Pewee	6	6	--	--	--	--	2.0
Wrentit	13	13	--	--	--	--	4.3
Marsh Hawk	4	4	--	--	1	1	1.7
Crow	422	422	2	2	1	1	141.7 ± 243
Common Flicker	4	4	--	--	--	--	1.3
White-crowned Sparrow	15	15	--	--	6	6	7.0
Scrub Jay	1	1	--	--	--	--	0.3
Turkey Vulture	12	12	--	--	--	--	4.0
Lazuli Bunting	1	1	--	--	--	--	0.3
Western Kingbird	1	1	--	--	--	--	0.3
Rufous-sided Towhee	1	1	--	--	--	--	0.3
Killdeer	1	1	--	--	--	--	0.3
Black Phoebe	2	2	--	--	--	--	0.7
Yellow-billed Magpie	34	34	--	--	--	--	11.3
Horned Lark	1	1	--	--	--	--	0.3
Brewer's Blackbird	45	45	--	--	--	--	15.0
White-tailed Kite	4	4	--	--	--	--	1.3
Cooper's Hawk	1	1	--	--	--	--	0.3
Starling	70	70	--	--	--	--	23.3
Canon Wren	1	1	--	--	--	--	0.3
Lark Sparrow	13	13	--	--	--	--	4.3
Western Bluebird	8	8	--	--	--	--	2.7
Golden-crowned Sparrow	--	--	2	2	--	--	0.7
Song Sparrow	--	--	1	1	--	--	0.3
Western Flycatcher	--	--	--	--	1	1	0.3
Total Relative Abundance	1759	1759	30	30	32	32	607.0 ± 998
Species Diversity Index	D_s = 6.41		D_s = 2.64		D_s = 5.77		4.94 ± 2.02

Ave/spp = 12.89 + 31.91

TABLE 4.5.7-8. Avian Relative Abundance Summary, Coastal Salt Marsh. (See Table 4.5.7-1 for explanation.)

Species	Autumn n	Autumn #/m-hr	Winter n	Winter #/m-hr	Spring n	Spring #/m-hr	Year Ave. $\bar{X} \pm$ SD (#/m-hr)
Marsh Hawk	9	12	--	--	--	--	4.0
White-tailed Kite	25	33	--	--	--	--	11.0
Long-billed Marsh Wren	25	33	2	4	--	--	12.3
Cliff Swallow	1	1	--	--	--	--	0.3
Red-tailed Hawk	1	1	--	--	--	--	0.3
Turkey Vulture	3	4	--	--	--	--	1.3
Savannah Sparrow	11	15	11	22	6	12	16.3 $\pm$ 5.1
Song Sparrow	22	29	--	--	--	--	9.7
Black Phoebe	1	1	--	--	--	--	0.3
House Finch	75	100	--	--	--	--	33.3
White-crowned Sparrow	--	--	5	10	--	--	3.3
Total Relative Abundance	173	229	18	36	6	12	92.3 $\pm$ 119
Species Diversity Index	D_s = 3.96		D_s = 2.23		D_s = 0.0		2.06 $\pm$ 1.99

Ave/spp = 8.37 $\pm$ 9.99

TABLE 4.5.7-9. Avian Relative Abundance Summary, Fresh Water Marshes and Lakes. (See Table 4.5.7-1 for explanation.)

Species	Autumn		Winter		Spring		Year Ave.
	n	#/m-hr	n	#/m-hr	n	#/m-hr	$\bar{X} \pm SD$ (#/m-hr)
American Coot	108	108	183	244	17	34	128.7 ± 107
Sora	--	--	2	3	--	--	1.0
Eared Grebe	1	1	2	3	--	--	1.3
Ruddy Duck	9	9	59	79	5	10	32.7 ± 40.1
Canvasback	--	--	1	1	--	--	0.3
Song Sparrow	93	93	--	--	12	24	39.0
Black Phoebe	4	4	--	--	1	2	2.0
Red-shouldered Hawk	1	1	--	--	--	--	0.3
Cliff Swallow	118	118	--	--	--	--	39.3
Evening Grosbeak	1	1	--	--	--	--	0.3
Allen's Hummingbird	4	4	--	--	--	--	1.3
Marsh Hawk	2	2	--	--	2	4	2.0
Common Yellowthroat	36	36	--	--	4	8	14.7
Lesser Goldfinch	26	26	--	--	--	--	8.7
Wilson's Warbler	2	2	--	--	--	--	0.7
Pied-billed Grebe	3	3	--	--	1	2	1.7
Mallard	23	23	--	--	--	--	7.7
Red-winged Blackbird	24	24	--	--	--	--	8.0
Least Sandpiper	24	24	--	--	--	--	8.0
Western Sandpiper	35	35	--	--	--	--	11.7
Wilson's Phalarope	5	5	--	--	--	--	1.7
White-tailed Kite	1	1	--	--	--	--	0.3
Killdeer	1	1	--	--	--	--	0.3
Black-necked Stilt	1	1	--	--	--	--	0.3
Northern Phalarope	38	38	--	--	--	--	12.7
Long-billed Marsh Wren	18	18	--	--	2	4	7.3
Black-throated Gray Warbler	1	1	--	--	--	--	0.3
Solitary Sandpiper	1	1	--	--	--	--	0.3
Green-winged Teal	1	1	--	--	--	--	0.3
Belted Kingfisher	2	2	--	--	--	--	0.7
Lesser Goldfinch	--	--	--	--	1	2	0.7
Cinnamon Teal	--	--	--	--	1	2	0.7
Total Relative Abundance	583	583	247	330	46	92	335.0 ± 245.5
Species Diversity Index	D_s = 8.38		D_s = 1.66		D_s = 4.52		4.85 ± 3.37

Ave/spp = 10.50 ± 23.72

TABLE 4.5.7-10. Avian Relative Abundance Summary, Coastal Lagoons. (See Table 4.5.7-1 for explanation.)

Species	Autumn n	Autumn #/m-hr	Winter n	Winter #/m-hr	Spring n	Spring #/m-hr	Year Ave. $\bar{X} \pm SD$ (#/m-hr)
Least Tern	11	11	--	--	--	--	3.7
Long-billed Curlew	18	18	--	--	--	--	6.0
Snowy Plover	94	94	80	80	--	--	58
Willet	77	77	16	16	--	--	31
Western Sandpiper	42	42	--	--	4	4	15.3
Whimbrel	5	5	--	--	--	--	1.7
Western Gull	17	17	740	740	82	82	280 ± 400
Heermann's Gull	22	22	--	--	--	--	7.3
Sanderling	58	58	--	--	--	--	19.3
Black-bellied Plover	3	3	6	6	--	--	3.0
Forster's Tern	4	4	--	--	--	--	1.3
Semi-palmated Plover	4	4	--	--	--	--	1.3
Black Turnstone	1	1	10	10	--	--	3.7
Brown Pelican	7	7	--	--	--	--	2.3
Least Sandpiper	78	78	--	--	1	1	26.3
Great Blue Heron	6	6	2	2	--	--	2.7
Snowy Egret	4	4	--	--	3	3	2.3
Eared Grebe	2	2	3	3	--	--	1.7
American Coot	3	3	--	--	29	29	10.7
Mallard	162	162	--	--	--	--	54
Green Heron	1	1	--	--	--	--	0.3
Caspian Tern	2	2	--	--	--	--	0.7
Ring-billed Gull	2	2	3240	3240	843	843	1362 ±1680
Ruddy Duck	13	13	7	7	1	1	7.0 ± 6.0
Northern Phalarope	32	32	--	--	--	--	10.7
Dowitcher	26	26	8	8	--	--	11.3
Marbled Godwit	10	10	12	12	--	--	7.3
Virginia Rail	1	1	1	1	--	--	0.7
Greater Yellowlegs	7	7	--	--	--	--	2.3
Pied-billed Grebe	5	5	3	3	--	--	2.7
Surf Scoter	4	4	--	--	--	--	1.3
Green-winged Teal	31	31	--	--	--	--	10.3
American Avocet	3	3	--	--	--	--	1.0
Song Sparrow	--	--	12	12	--	--	4.0
American Bittern	--	--	2	2	--	--	0.7
Western Grebe	--	--	2	2	--	--	0.7
Great Egret	--	--	1	1	--	--	0.3
Spotted Sandpiper	--	--	1	1	--	--	0.3
Sora	--	--	1	1	--	--	0.3
Belted Kingfisher	--	--	1	1	--	--	0.3
Long-billed Marsh Wren	--	--	8	8	6	6	4.7
Cinnamon Teal	--	--	--	--	5	6	2.0
Royal Tern	--	--	--	--	4	4	1.3
Total Relative Abundance	755	755	4156	4156	979	979	1963 ±1902
Species Diversity Index		$D_S = 10.18$		$D_S = 1.56$		$D_S = 1.33$	4.36± 5.04

Ave/spp = 44.63 ± 208

TABLE 4.5.7-11. Avian Relative Abundance Summary, Coastal Strand. (See Table 4.5.7-1 for explanation.)

Species	Autumn #/m-hr	Winter #/m-hr	Spring #/m-hr	Year Ave. $\bar{X} \pm$ SD (#/m-hr)
Water Pipit	--	2	--	0.7
Black Turnstone	14	43	--	19
Western Gull	475	250	466	397 ± 127
Heermann's Gull	289	75	115	160 ± 114
Whimbrel	83	1	--	28
Willet	171	66	139	125 ± 53.8
Red-breasted Merganser	1	--	--	0.3
Surf Scoter	144	--	11	51.7
Brown Pelican	98	--	3	33.7
Wandering Tattler	13	--	--	4.3
Pigeon Guillemot	17	--	--	5.7
Brandt's Cormorant	519	--	--	173
Sooty Shearwater*	1.2×10^6*	--	--	*
Killdeer	5	--	--	1.7
Bonaparte's Gull	2	--	--	0.7
Black Oystercatcher	3	--	--	1.0
Marbled Godwit	9	--	19	9.3
Black-bellied Plover	117	--	11	42.7
Long-billed Curlew	37	--	--	12.3
Least Sandpiper	72	--	--	24.0
Snowy Plover	70	--	--	23.3
Dowitcher	6	--	--	2.0
Pied-billed Grebe	1	--	--	0.3
Sanderling	230	1	181	137 ± 121
Caspian Tern	4	--	--	1.3
Common Murre	4	--	--	1.3
Spotted Sandpiper	--	5	--	2.0
Total Relative Abundance	2384	443	946	1258 ±1007
Species Diversity Index	$D_s = 7.87$	$D_s = 2.65$	$D_s = 3.17$	4.56± 2.88

Ave/spp = 48.36 ± 88.3

* excluded from calculations (see text)

5. - REFERENCES

1. Wood, E.D., F.A.J. Armstrong, and F.A. Richards, Determination of Nitrate in Sea Water by Cadmium-Copper Reduction to Nitrite, J. Mar. Biol. Assn. U.K., 47, pp. 23-31, 1967.

2. American Public Health Association, Standard Methods for the Examination of Water and Waste Water, 13th Ed. Amer. Pub. Health Assn. Pub. Office, Wash., D.C., 1971.

3. Strickland, J.D.H., and T.R. Parsons, A Practical Handbook of Seawater Analysis, Fisheries Research Bd. of Canada, Ottawa, 1968.

4. Munz, P.A., A Flora of Southern California, Univ. of Calif. Press, Berkeley, 1974.

5. Miller, R.R., and C.L. Hubbs, Systematics of *Gasterosteus aculeatus*, with Particular Reference to Intergradation and Introgression along the Pacific Coast of North America: A Commentary on a Recent Contribution. Copeia, 1969(1), pp. 2-69, 1969.

6. Sasaki, K., Personal communication, Assistant Fisheries Biologist, California Department of Fish and Game, Long Beach, 1975.

7. Carlander, K.D., Handbook of Freshwater Fishery Biology, Wm. C. Brown Co., Dubuque, Iowa, 1950.

8. Calhoun, A., Inland Fisheries Management, State of California Dept. of Fish and Game, 1966.

9. Jones, A.C., The Biology of the Euryhaline Fish *Leptocottus armatus armatus* Girard, Univ. Calif. Pub. Zool., 67, pp. 321-367, 1962.

10. Rodrigue, R.F., G.J. Bakus, E.K. Noda, Interim Report: Coastal Environmental Survey of the Vandenberg AFB Region, California, Tetra Tech. Report No. TC-439, Part 1, 1974.

11. Shelton, P., Ecological Studies of Beaver Wolves and Moose in Isle Royale National Park, Mich., Ph.D. Thesis Purdue University, 1966.

12. Munz, P.A., and D. Keck, A California Flora, Unif. of Calif. Press, Berkeley, 1959.

13. Cheatham, N.H., A Checklist of California Habitat Types, Univ. of Calif. Natural Land and Water Reserve System, Unpublished Ms., 1973.

14. Powell, R.W., An Inventory of the Rare and Endangered Plants of California, Calif. Native Plant Soc. Special Pub. No. 2, 1974.

15. Vogt, W., A Practical Lizard Trap, Copeia 2, p. 115, 1941.

16. Banta, B.H., A Simple Live-trap for Collecting Desert Reptiles, Herpetologica, 13(3), pp. 174-176, 1957.

17. Simpson, E.H., Measurement of Divsersity, Nature, 163, p. 688, 1949.

18. McKeown, M.S., Checklist of Amphibians and Reptiles of Santa Barbara County, Calif., Santa Barbara Mus. Nat. Hist. Occ. Paper 9, 1974.

19. Stebbins, R.C., Amphibians and Reptiles of Western North America, McGraw-Hill Book Company, Inc., New York, 1954.

20. Schmidt, K.P., A Check-list of North American Amphibians and Reptiles, Univ. of Chicago Press, Chicago, 1953.

21. Office of Endangered Species, Threatened Wildlife of the U.S., Bureau of Sport Fisheries and Wildlife, U.S. Dept. of the Interior, Resource Pub. 114, 1974.

22. Wetmore, A., et al., Check-list of North American Birds, Am. Ornithologists' Union, Port-City Press, Baltimore, 1957.

23. Eisemann, E., et al., Thirty-second Supplement to the American Ornithologists' Union Check-list of North American Birds, Auk, 90, pp. 411-419, 1973.

24. Grinnell, J., and A.H. Miller, The Distribution of the Birds of California, Pacific Coast Avifauna, 27, pp. 1-608, 1944.

25. Hall, E.R., and K.R. Kelson, The Mammals of North America, The Ronald Press Co., New York, 2 vols., 1959.

26. Ingles, L.G., Mammals of the Pacific States, Stanford Univ. Press, Palo Alto, 1965.

27. Compton, D.E., Evaluation of the Deer-aircraft Collision Hazard at Vandenberg AFB, CA, Air Force Weapons Lab., Kirkland AFB, New Mexico, AFWL-DE-TN-73-022, 1973.

28. Gilmore, R.M., The Gray Whale, Oceans, 1(1), pp. 9-20, 1969.

29. Caldwell, K., and M.D. Caldwell, Surf Riding in the California Gray Whale, Bull. So. Calif. Acad. Sci., 62, p. 99, 1973.

30. Wild, P.W., Sea Otters: Research and Management Implications in California, Calif. Dept. Fish and Game, Unpublished Ms., 1973.

31. Barabash-Nikiforov, The Sea Otter, Israel Program for Scientific Translations, Jerusalem, 1962.

32. Scheffer, V.B., Seals, Sea Lions, and Walruses, Stanford Univ, Press, Stanford, Calif., 1958.

6. - APPENDIX

Permanent Quadrat Location Sheets

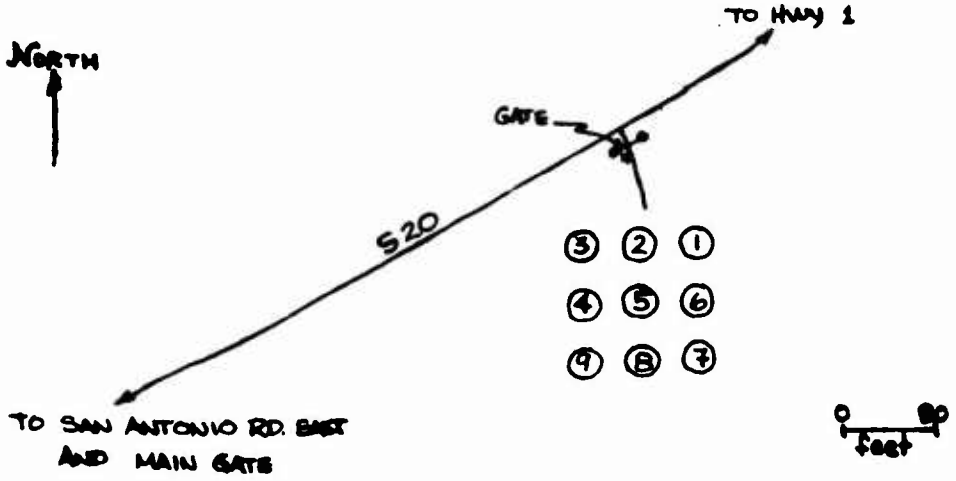
QUADRAT CHARACTERISTICS

Base Map No. 21 Grid Cell Location LC-103.6

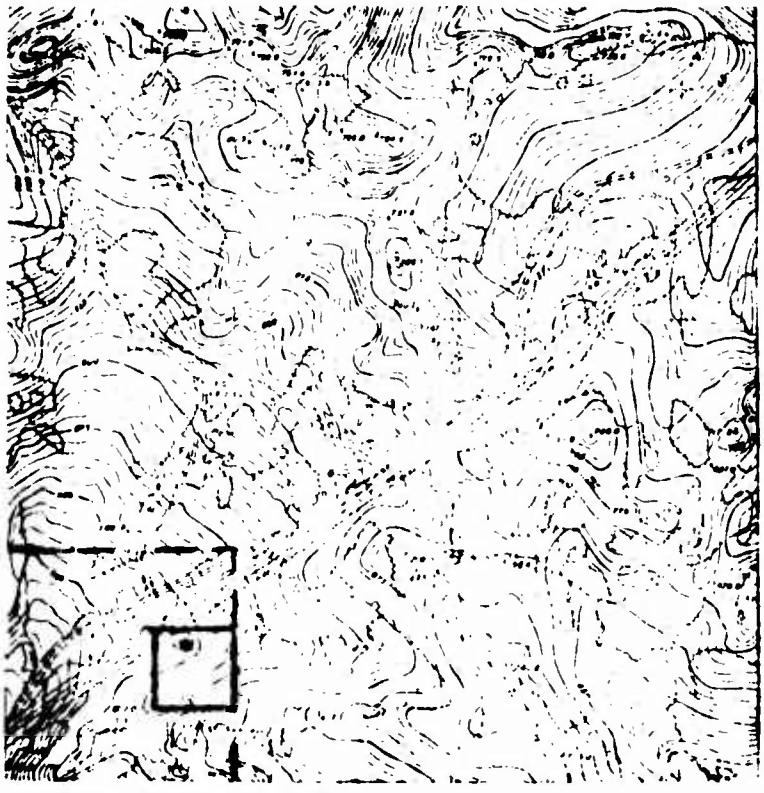
Vegetation Type OAK WOODLAND

Remarks SPARSE UNDERSTORY; SOME INDICATION OF GRAZING

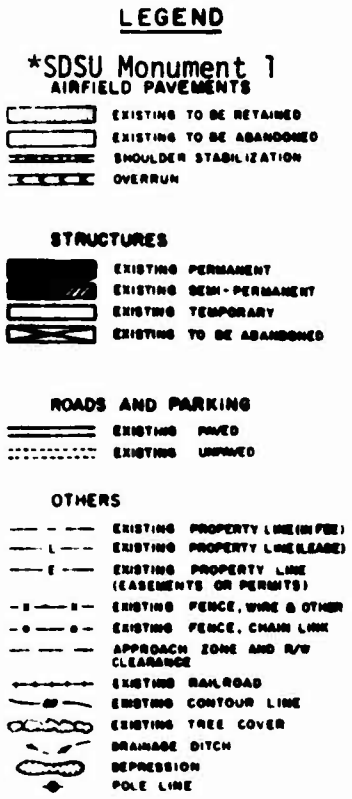
Slope Exposure NW Mean Elevation of Quadrat 550'



Reference Directions 2.1 MI NE OF SAN ANTONIO RD. EAST. FOURTH TURN-OFF ON RIGHT. NOTE SIGN "WILDLIFE CONTROL AREA"



Contour Interval=5 feet



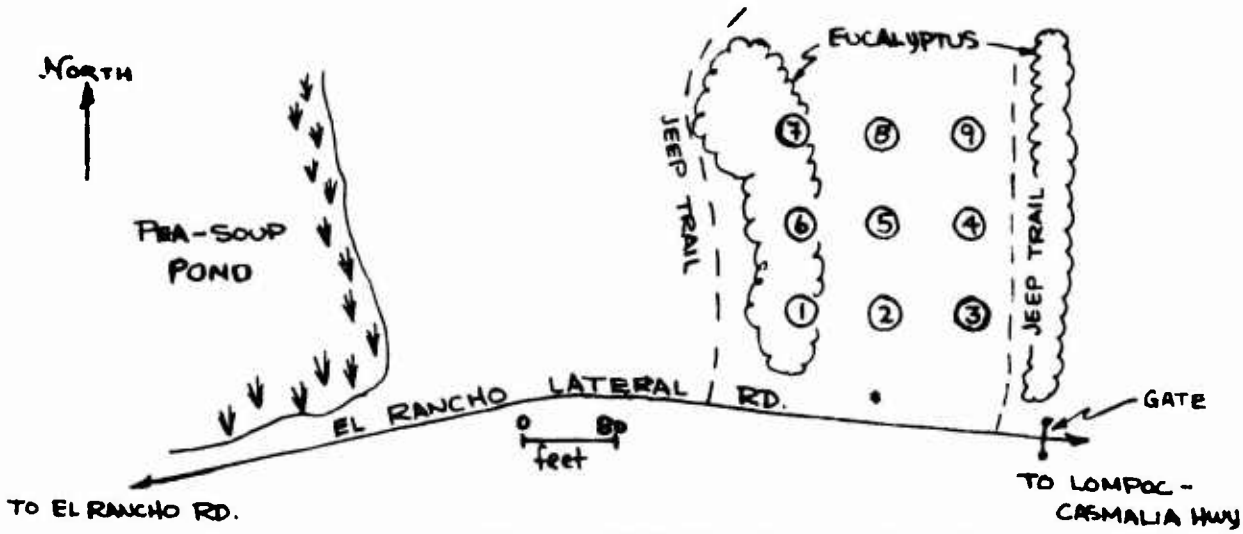
QUADRAT CHARACTERISTICS

Base Map No. 23 Grid Cell Location EB-100.7

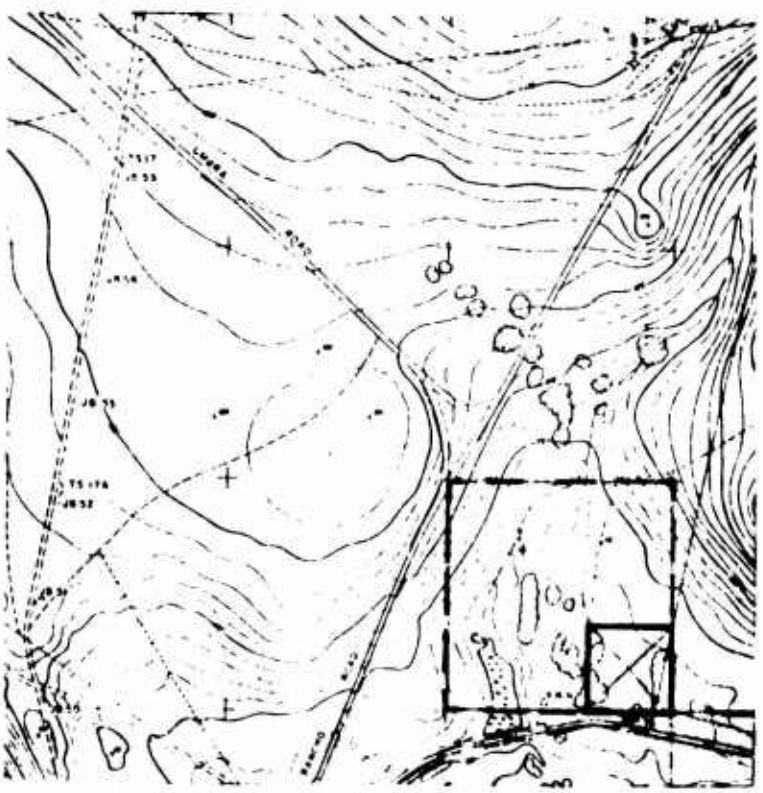
Vegetation Type ANNUAL GRASSLAND

Remarks

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 70'



Reference Directions 0.3 MI E OF EL RANCHO RD, CA. 400'E OF PEA-SOUP LAKE; EAST-WEST BORDER OF EUCALYPTUS; GATE ALWAYS LOCKED



LEGEND

*SDSU Monument 3

AIRFIELD PAVEMENTS

- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES

- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING

- EXISTING PAVED
- EXISTING UNPAVED

OTHERS

- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

Contour Interval=5 feet

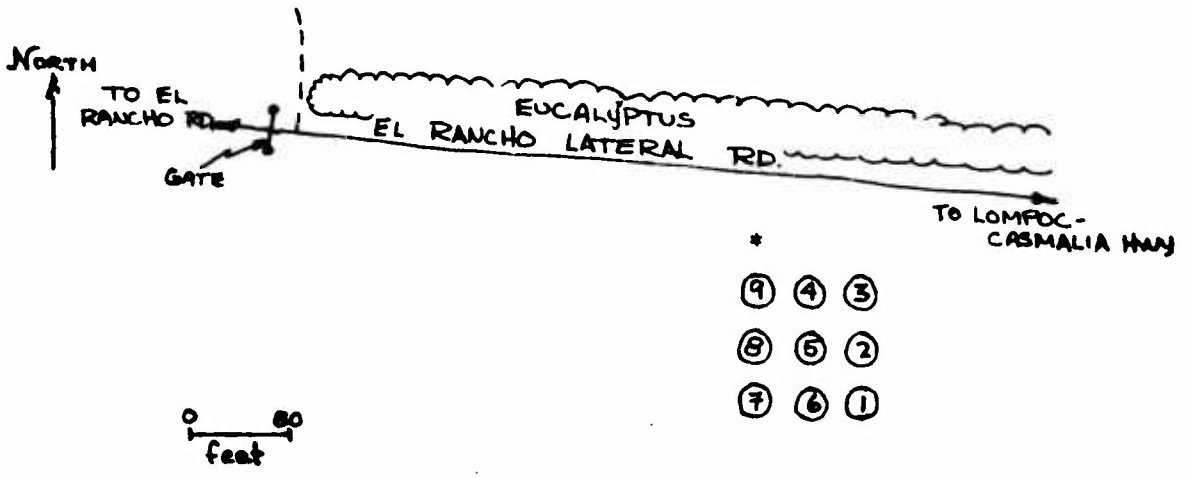
QUADRAT CHARACTERISTICS

Base Map No. 23 Grid Cell Location FB-99.5

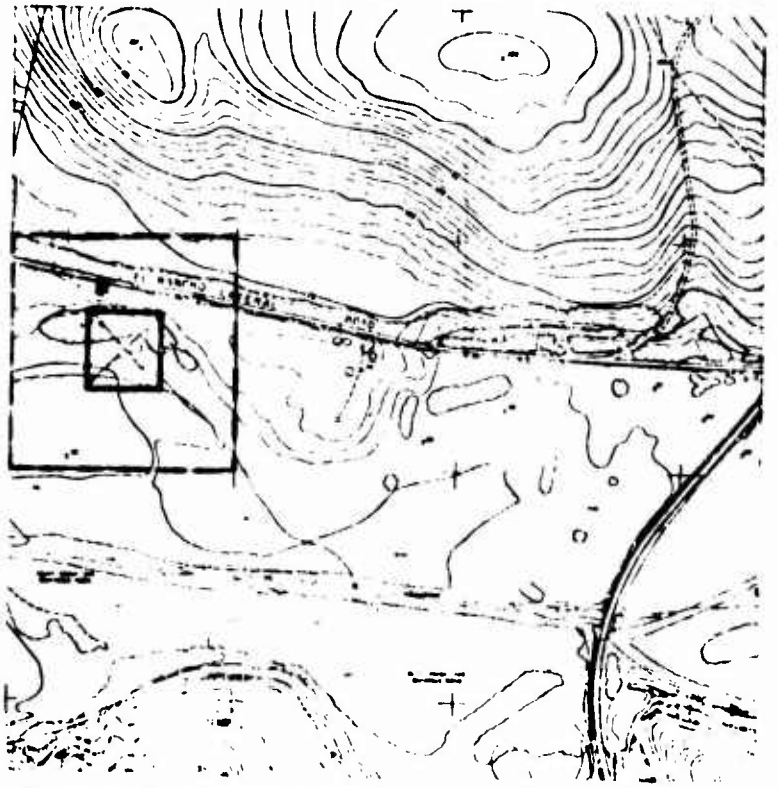
Vegetation Type RIPARIAN WOODLAND

Remarks DENSE PHASE WITH SPARSE UNDERSTORY

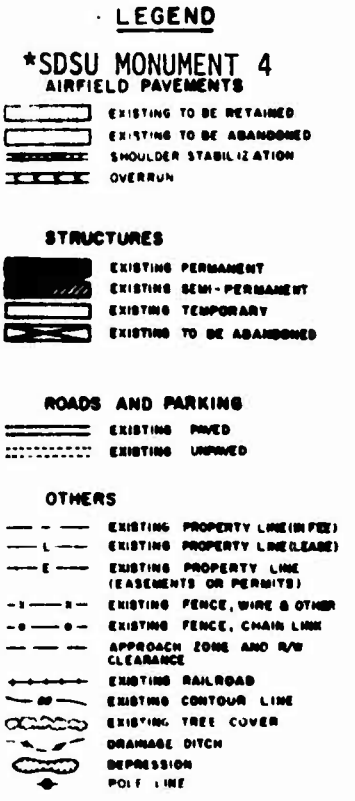
Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 55'



Reference Directions 0.6 MI W OF LOMPOC-CASMALIA HWY AND 0.4 MI E OF EL RANCHO RD.; GATE ALWAYS LOCKED; QUADRAT CA. 500' E OF GATE



Contour Interval=5 feet



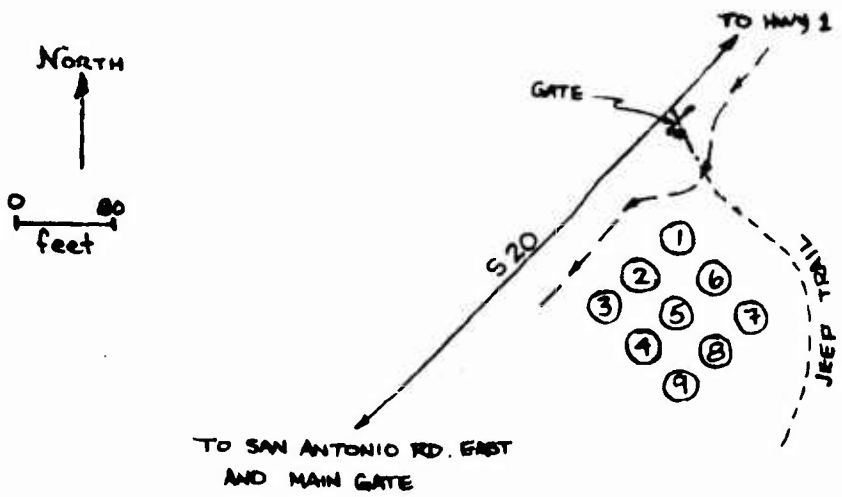
QUADRAT CHARACTERISTICS

Base Map No. 25 Grid Cell Location JC-90.2

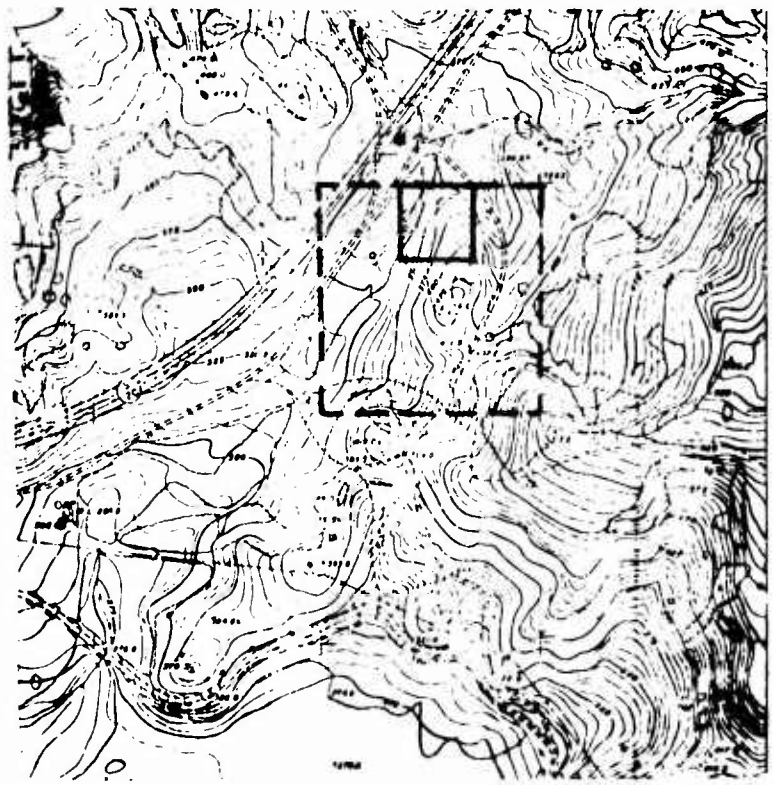
Vegetation Type OAK WOODLAND

Remarks SPARSE PHASE

Slope Exposure NW Mean Elevation of Quadrat 375'



Reference Directions QUADRAT LOCATED 1.4 MI NE OF SAN ANTONIO RD. EAST SECOND TURN-OFF ON RIGHT. NOT SIGN "WILDLIFE CONTROL AREA"



LEGEND

* SDSU Monument 2

AIRFIELD PAVEMENTS
- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES
- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING
- EXISTING PAVED
- EXISTING UNPAVED

OTHERS
- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

Contour Interval=5 feet

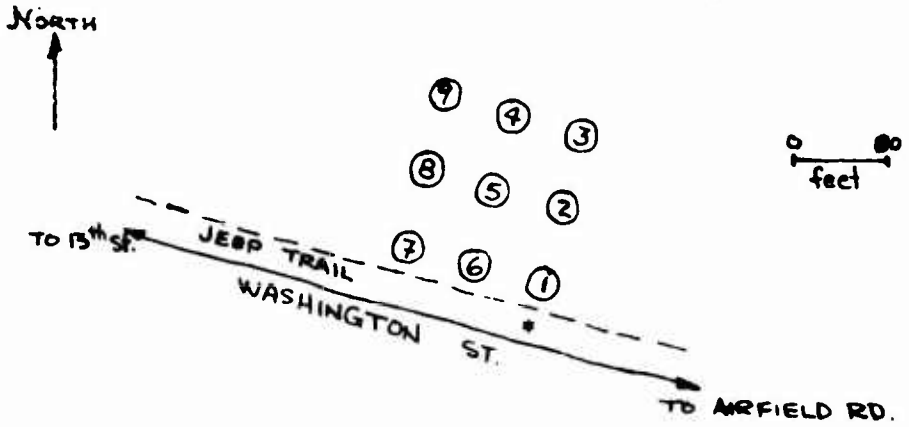
QUADRAT CHARACTERISTICS

Base Map No. 28 Grid Cell Location HB-87.6

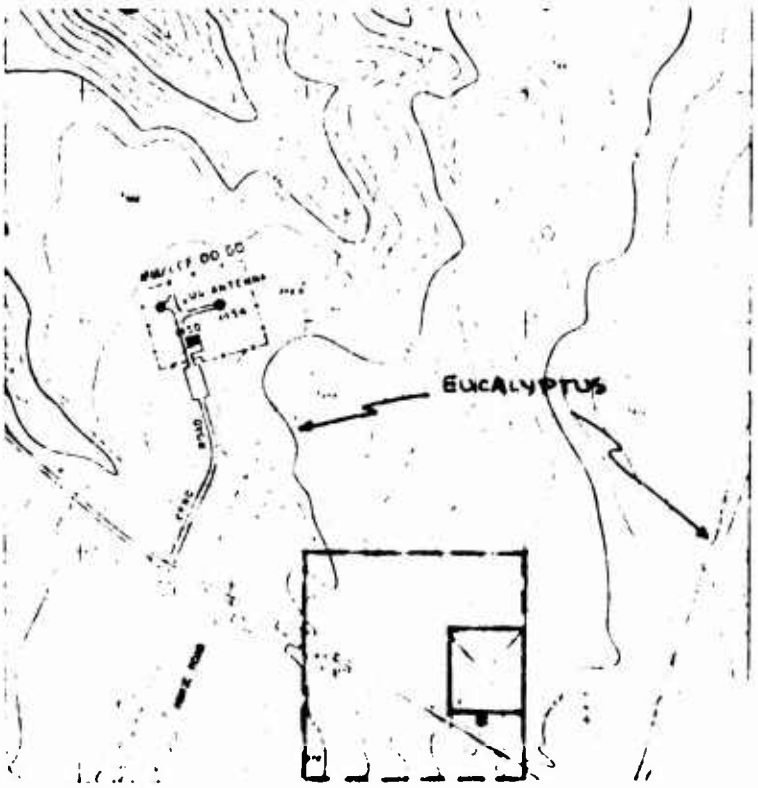
Vegetation Type CHAPARRAL

Remarks DENSE PHASE

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 395'



Reference Directions QUADRAT LOCATED 0.3 MI W OF AIRFIELD RD. AND 0.8 MI E OF 13th STREET BETWEEN TWO DISTANT EUCALYPTUS STANDS.



LEGEND

* SDSU Monument 5

AIRFIELD PAVEMENTS

EXISTING TO BE RETAINED

EXISTING TO BE ABANDONED

SHOULDER STABILIZATION

OVERRUN

STRUCTURES

EXISTING PERMANENT

EXISTING SEMI-PERMANENT

EXISTING TEMPORARY

EXISTING TO BE ABANDONED

ROADS AND PARKING

EXISTING PAVED

EXISTING UNPAVED

OTHERS

EXISTING PROPERTY LINE (IN FEE)

EXISTING PROPERTY LINE (LEASE)

EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)

EXISTING FENCE, WIRE & OTHER

EXISTING FENCE, CHAIN LINK

APPROACH ZONE AND R/W CLEARANCE

EXISTING RAILROAD

EXISTING CONTOUR LINE

EXISTING TREE COVER

DRAINAGE DITCH

DEPRESSION

Contour Interval=5 feet

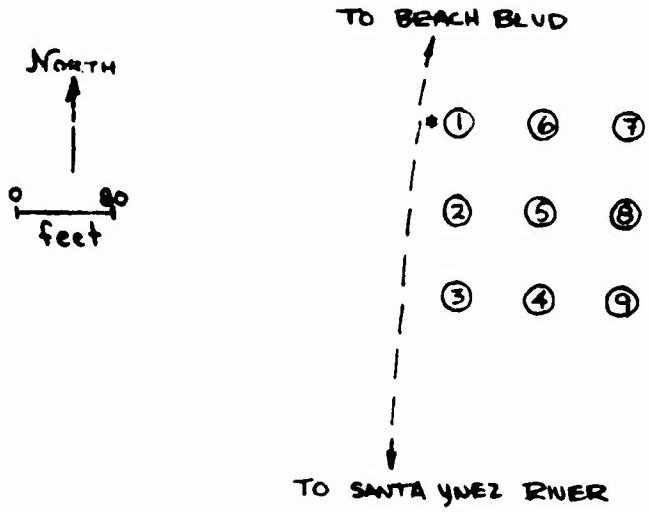
QUADRAT CHARACTERISTICS

Base Map No. 41 Grid Cell Location VA-69.3

Vegetation Type COASTAL SALT MARCH

Remarks PREDOMINANTLY SALICORNIA

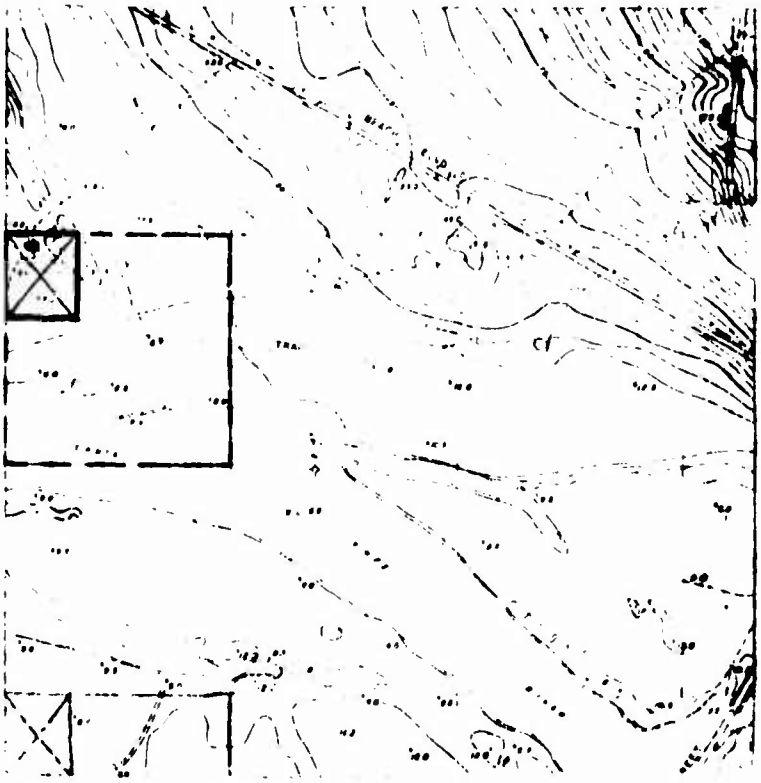
Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 6'



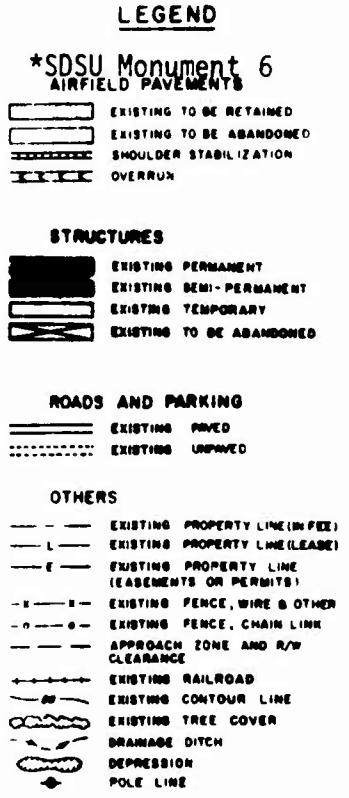
NOTE: ALWAYS TURN LEFT; FOLLOW SIGN "VISITING CIVILIAN FISHING BEACH"

Reference Directions TERRA RD. TO BEACH BLVD (CANINE SOD ON CORNER):

2.0 MI W OF BEACH BLVD. 1st TURN-OFF ON LEFT: 0.3 MI FROM BEACH BLVD TO QUADRAT.



Contour Interval=5 feet



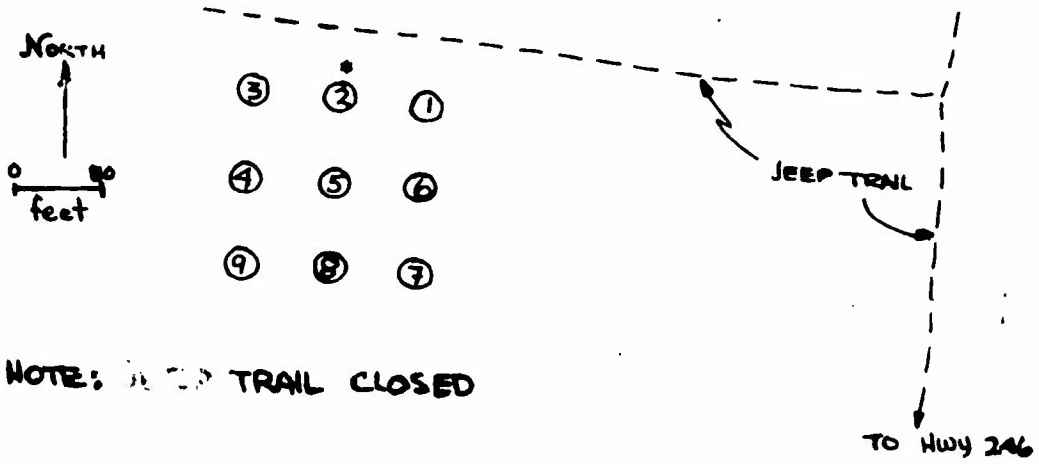
QUADRAT CHARACTERISTICS

Base Map No. 41 Grid Cell Location VA-67.3

Vegetation Type COASTAL SALT MARSH

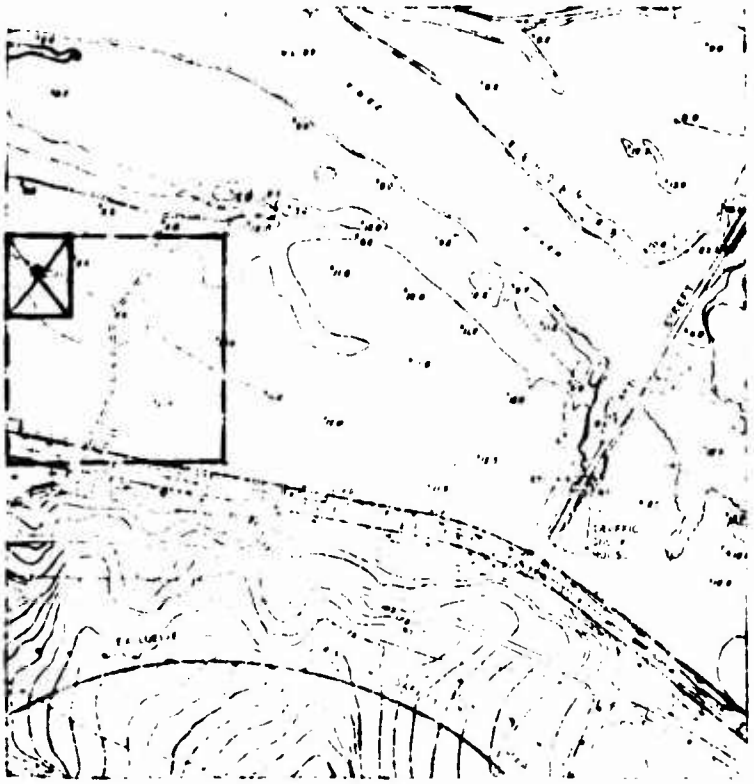
Remarks PREDOMINANTLY SALICORNIA

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 8'

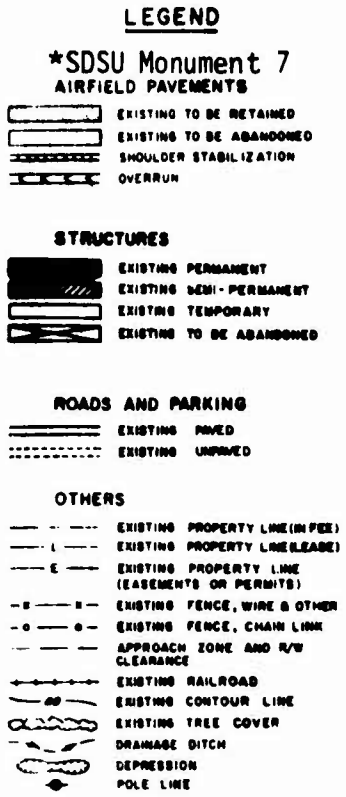


NOTE: JEEP TRAIL CLOSED

Reference Directions 0.5 MI W OF JUNC. HWY 246 AND OCEAN PARK RD; PARK BY "OCEAN BEACH PARK" SIGN, CROSS RR TRACKS AND PROCEED NORTH AS ABOVE



Contour Interval=5 feet



QUADRAT CHARACTERISTICS

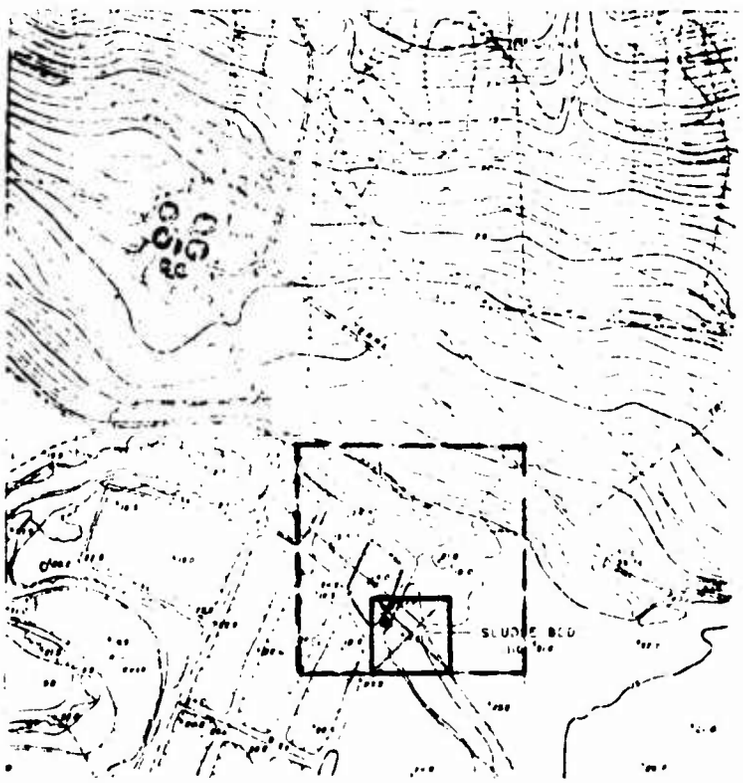
Base Map No. 41 Grid Cell Location FB-66.8

Vegetation Type RIPARIAN WOODLAND

Remarks SPARSE UNDERSTORY

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 20'

Reference Directions 0.2 MI W OF TERRA RD; PASS CATTLE GATE AND STAY TO THE LEFT (SOUTH) ON DIRT RD; QUADRAT IN 2nd WILLOW STAND ON LEFT.



LEGEND

*SDSU Monument 8

AIRFIELD PAVEMENTS
EXISTING TO BE RETAINED
EXISTING TO BE ABANDONED
SHOULDER STABILIZATION
OVERRUN

STRUCTURES
EXISTING PERMANENT
EXISTING SEMI-PERMANENT
EXISTING TEMPORARY
EXISTING TO BE ABANDONED

ROADS AND PARKING
EXISTING PAVED
EXISTING UNPAVED

OTHERS
EXISTING PROPERTY LINE (IN FEE)
EXISTING PROPERTY LINE (LEASE)
EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
EXISTING FENCE, WIRE
EXISTING FENCE, CHAIN LINK
APPROACH ZONE AND R/W CLEARANCE
EXISTING RAILROAD
EXISTING CONTOUR LINE
EXISTING TREE COVER
DRAINAGE DITCH
DEPRESSION
POLE LINE

Contour Interval=5 feet

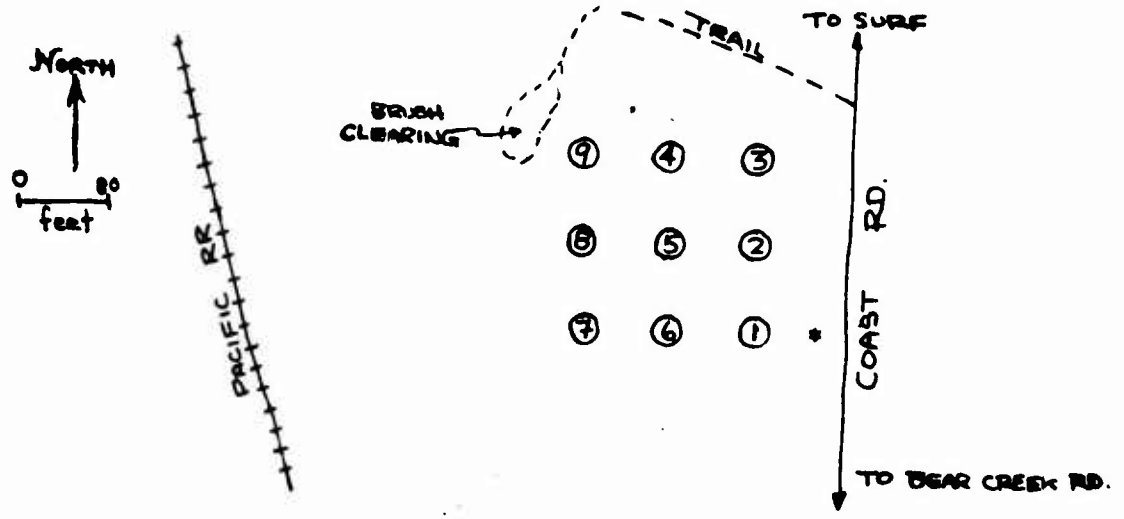
QUADRAT CHARACTERISTICS

Base Map No. 44 Grid Cell Location SA-62.9

Vegetation Type COASTAL SAGE SCRUB

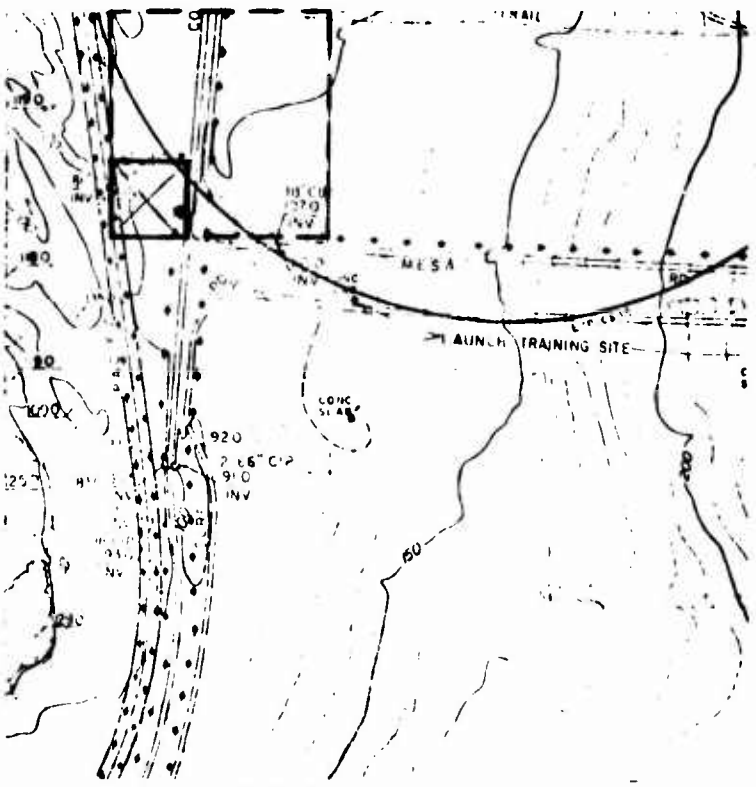
Remarks SPARSE PHASE STABILIZED DUNE, PREDOMINANTLY HAPLOPAPPUS

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 95'

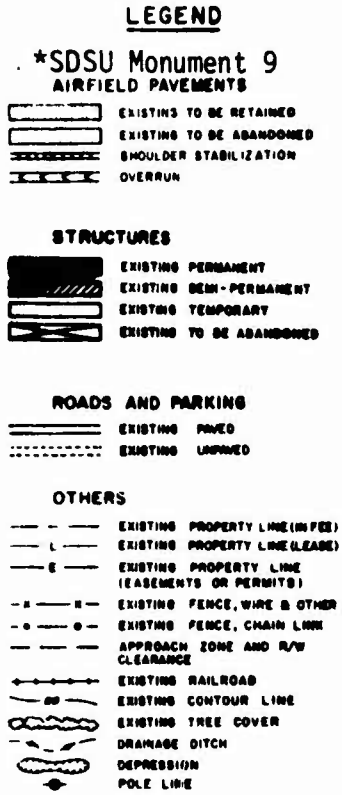


Reference Directions 1.4 MI N OF BEAR CREEK RD ≈ 200' N OF MESA RD;

EUCALYPTUS BORDERING EAST SIDE OF COAST RD



Contour Interval=5 feet



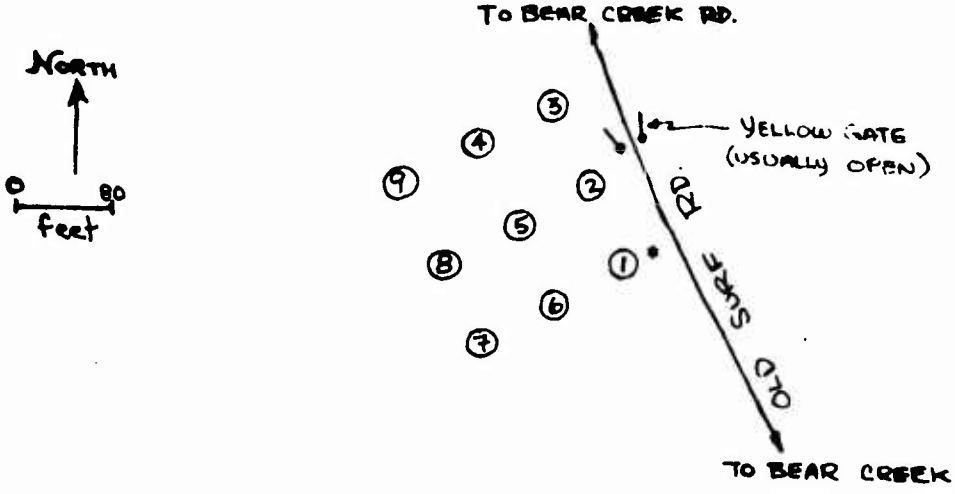
QUADRAT CHARACTERISTICS

Base Map No. 47 Grid Cell Location RA-55.8

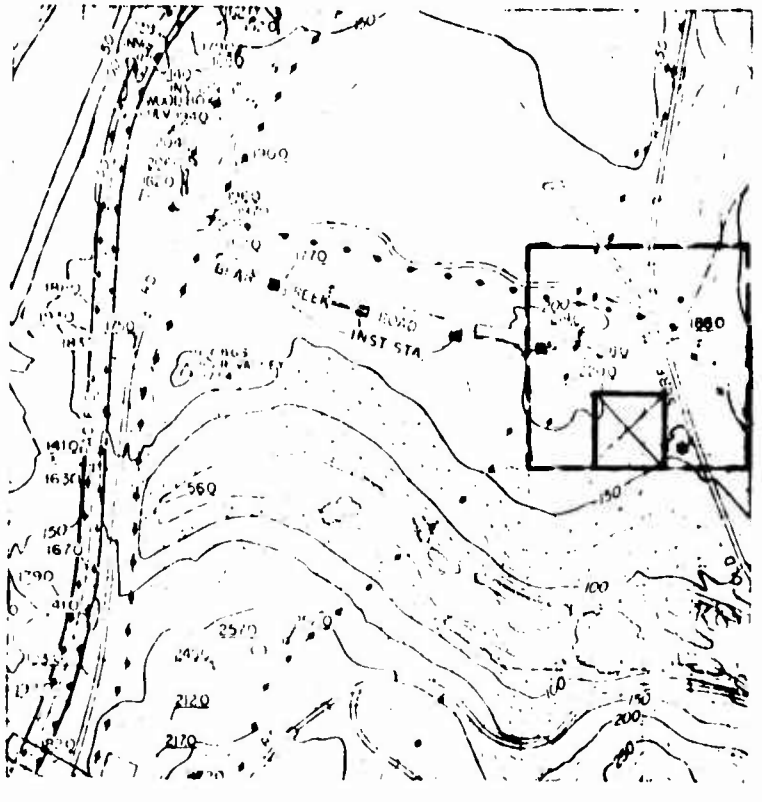
Vegetation Type COASTAL SAGE SCRUB DINE, STABILIZED

Remarks DENSE PHASE

Slope Exposure NE Mean Elevation of Quadrat 165'



Reference Directions ≈ 0.1 MI SOUTH OF BEAR CREEK RD; YELLOW GATE MARKS CENTER LINE OF QUADRAT.



LEGEND

*SDSU Monument 10

AIRFIELD PAVEMENTS
- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES
- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING
- EXISTING PAVED
- EXISTING UNPAVED

OTHERS
- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

Contour Interval=5 feet

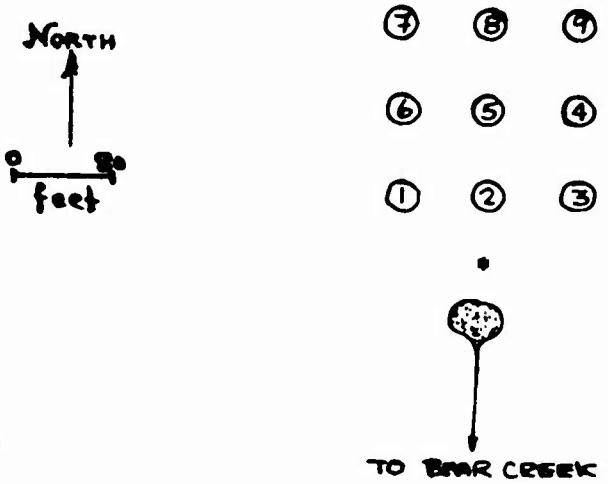
QUADRAT CHARACTERISTICS

Base Map No. 47 Grid Cell Location VA-53.8

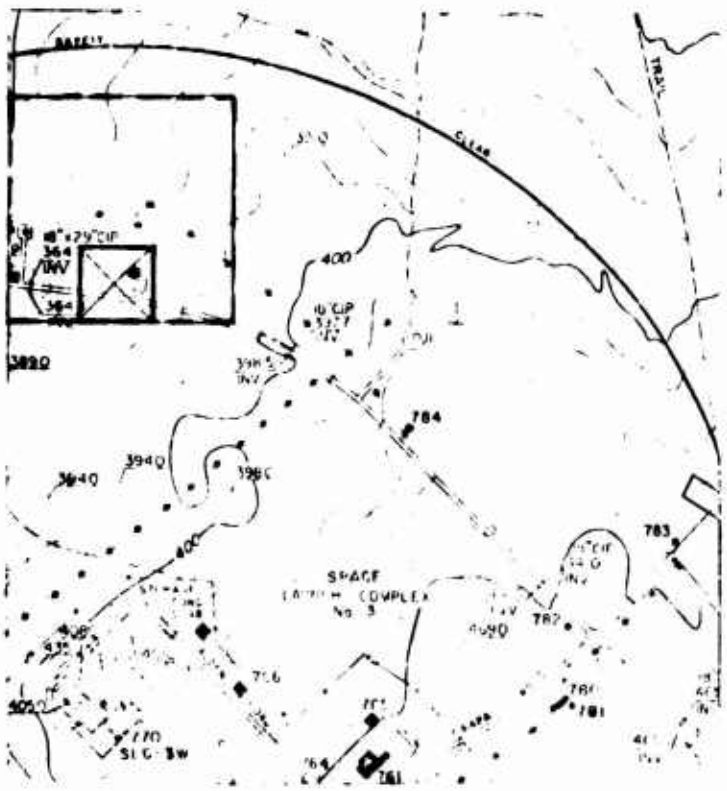
Vegetation Type ANNUAL GRASSLAND

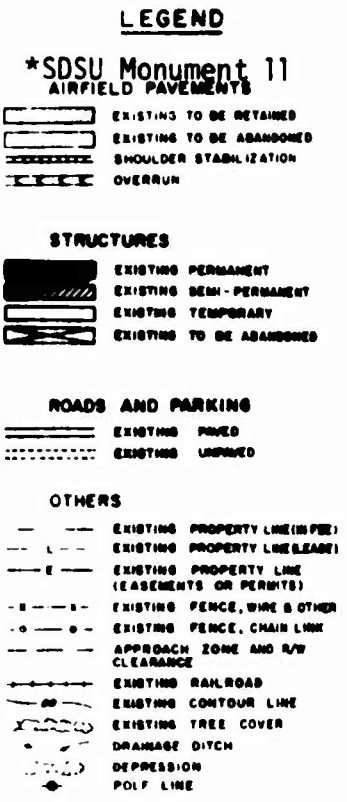
Remarks PREDOMINANTLY HEMIZONIA

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 390'



Reference Directions 1.3 MI E OF COAST RD AND 1.4 MI W OF ARGUELLO RD. JUST WEST OF LARGE STORAGE TANK.





Contour Interval=5 feet

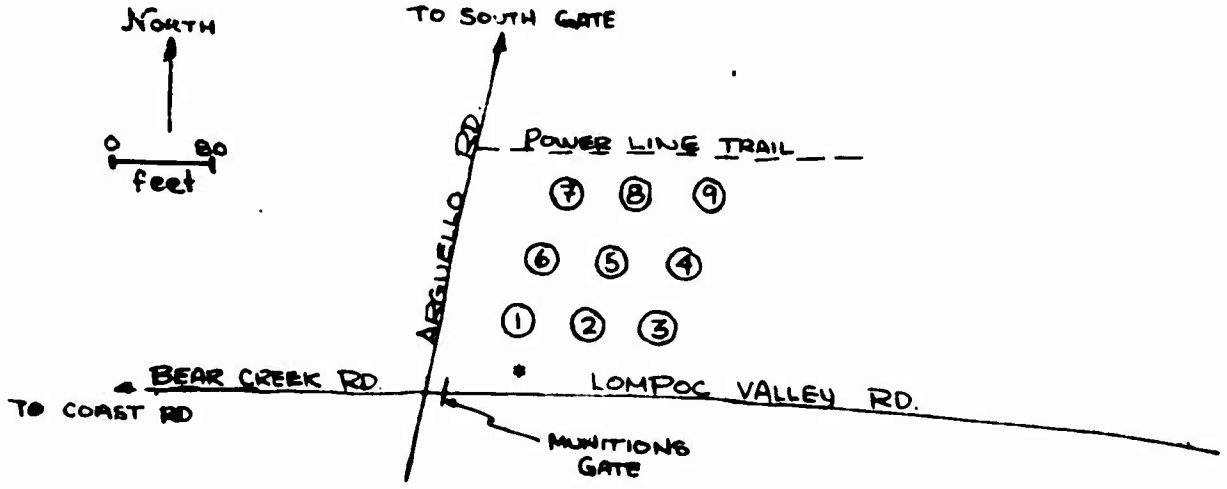
QUADRAT CHARACTERISTICS

Base Map No. 48 Grid Cell Location CB-50.5

Vegetation Type CHAPARRAL

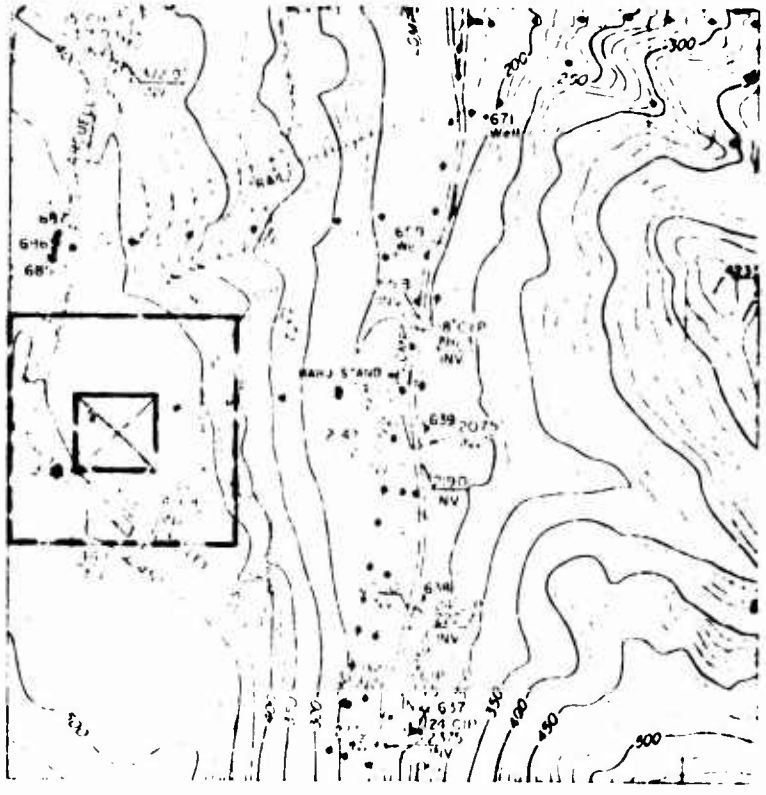
Remarks DENSE PHASE

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 445'



Reference Directions NE CORNER OF ARGUELLO RD AND LOMPOC VALLEY RD

JUST BEYOND MUNITIONS GATE.



LEGEND

*SDSU Monument 12

AIRFIELD PAVEMENTS
- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES
- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING
- EXISTING PAVED
- EXISTING UNPAVED

OTHERS
- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

Contour Interval=5 Feet

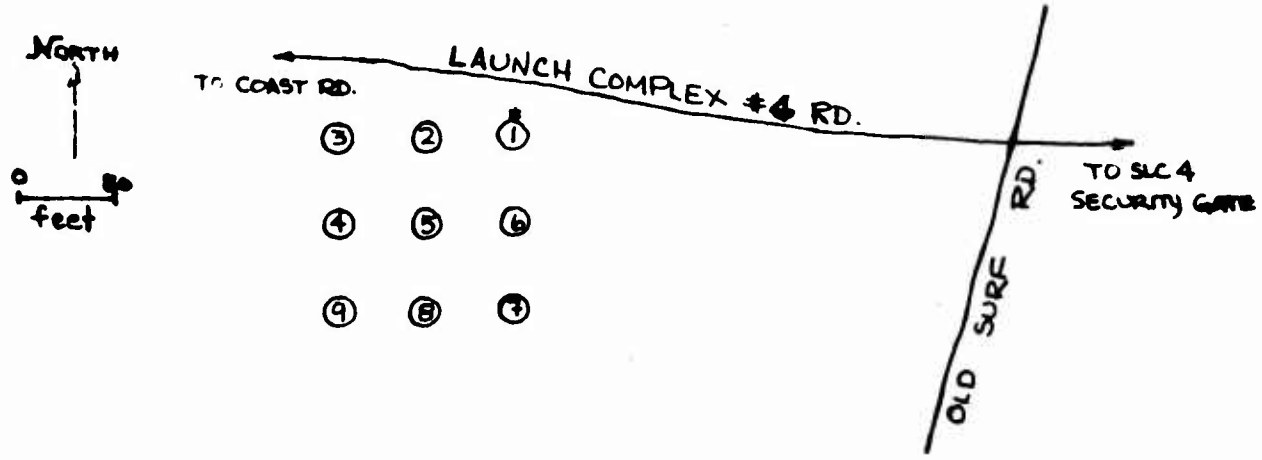
QUADRAT CHARACTERISTICS

Base Map No. 49 Grid Cell Location NA-48.2

Vegetation Type COASTAL SAGE SCRUB DUNE, STABILIZED

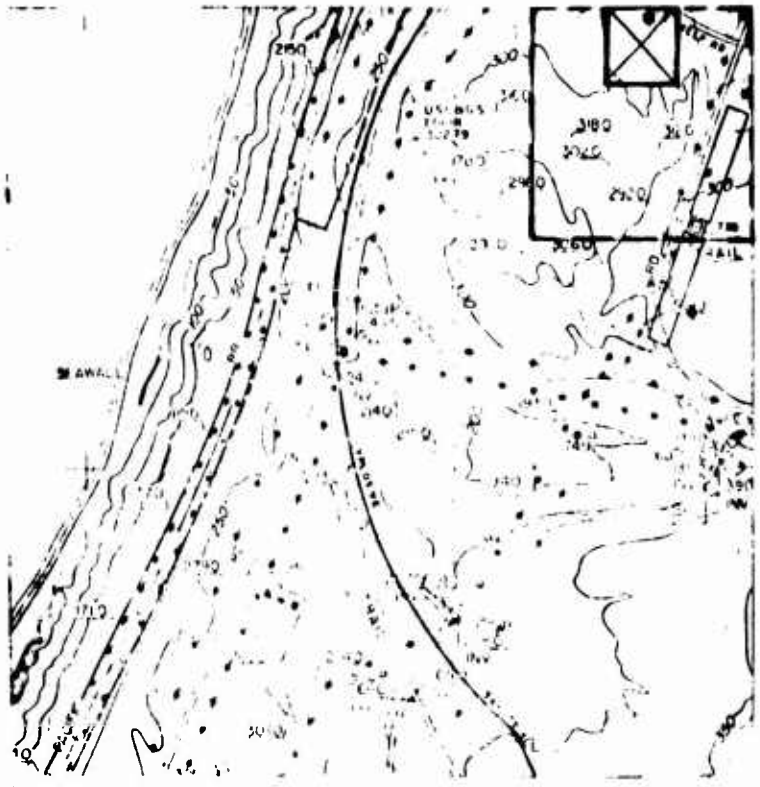
Remarks SPARSE PHASE

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 295'

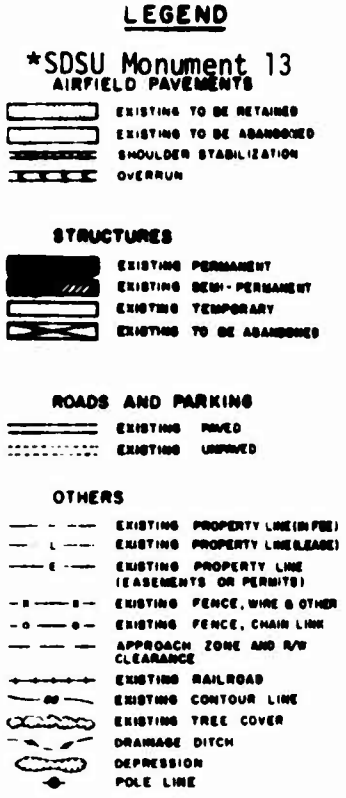


Reference Directions 0.1 MI W OF OLD SURF RD AND 0.1 MI E OF COAST RD.

LC#4 RD=KELP RD



Contour Interval=5 feet



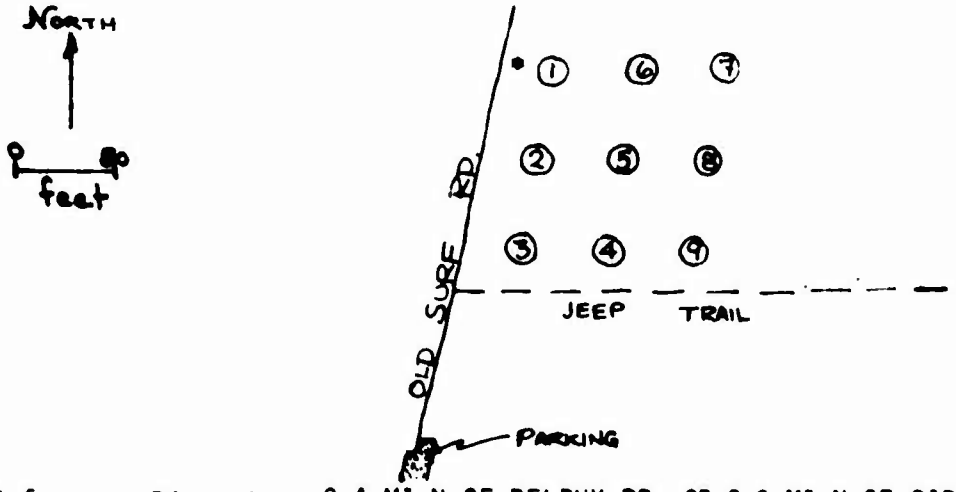
QUADRAT CHARACTERISTICS

Base Map No. 49 Grid Cell Location KA-42,6

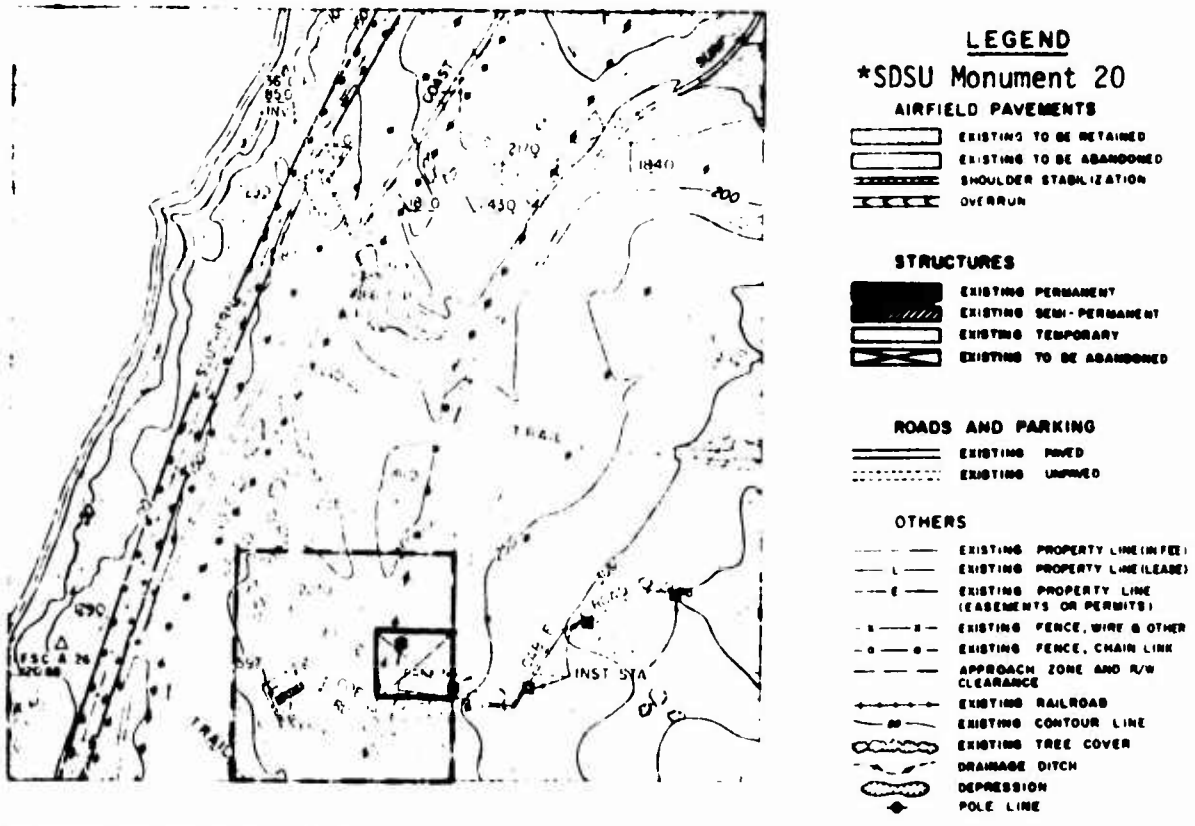
Vegetation Type COASTAL SAGE SCRUB

Remarks DENSE PHASE STABILIZED DUNE, PREDOMINANTLY HAPLOPAPPUS

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 240'



Reference Directions 0.4 MI N OF DELPHY RD, OR 0.3 MI N OF CABLE RD NEAR BLDG. 596 AND 1.5 MI S OF LAUNCH COMPLEX #4 RD.



Contour Interval=5 feet

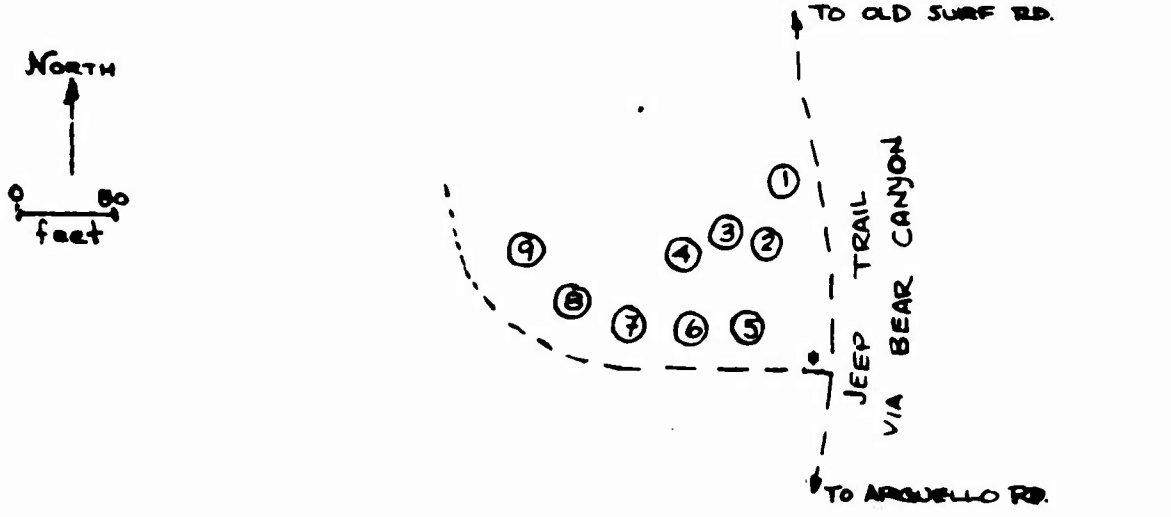
QUADRAT CHARACTERISTICS

Base Map No. 50 Grid Cell Location WA-44.6

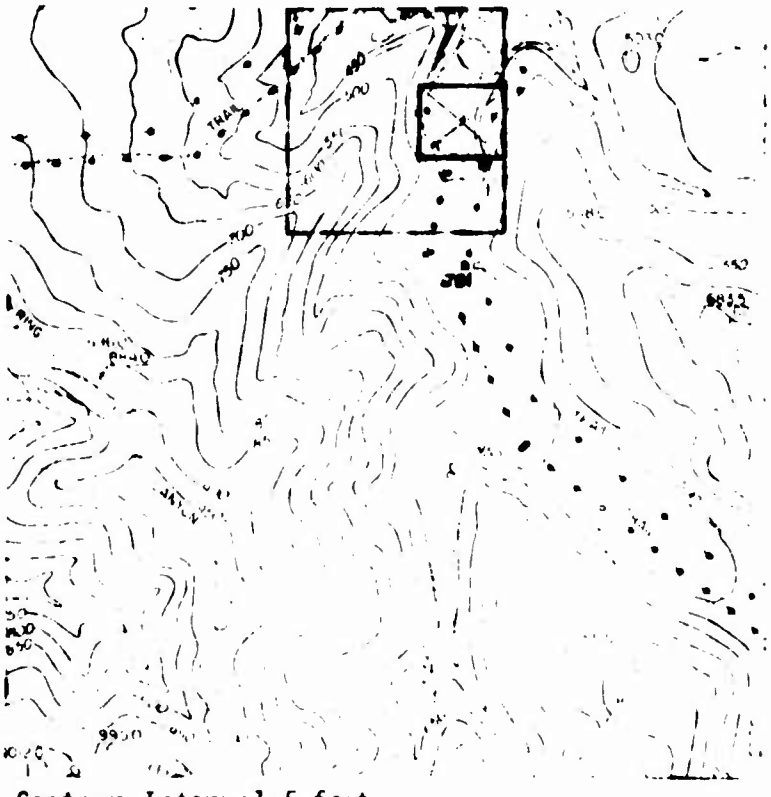
Vegetation Type RIPARIAN WOODLAND

Remarks DENSE PHASE

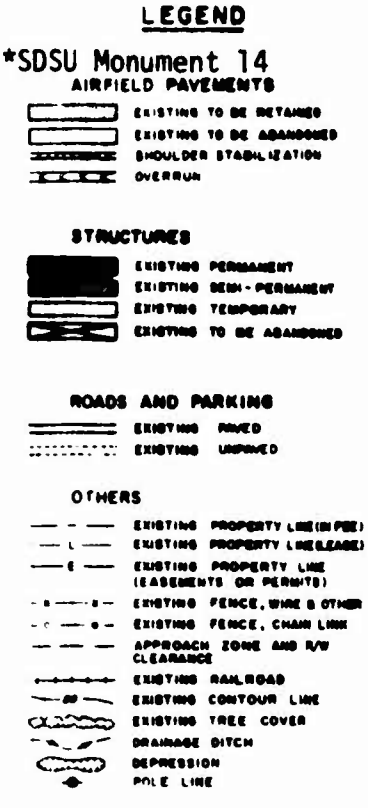
Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 445'



Reference Directions 2.1 MI SE OF OLD SURF RD AND 1.7 MI FROM ARGUELLO RD; NEAR BLDG 701, WEST ABOUT 300 FT.



Contour Interval=5 feet



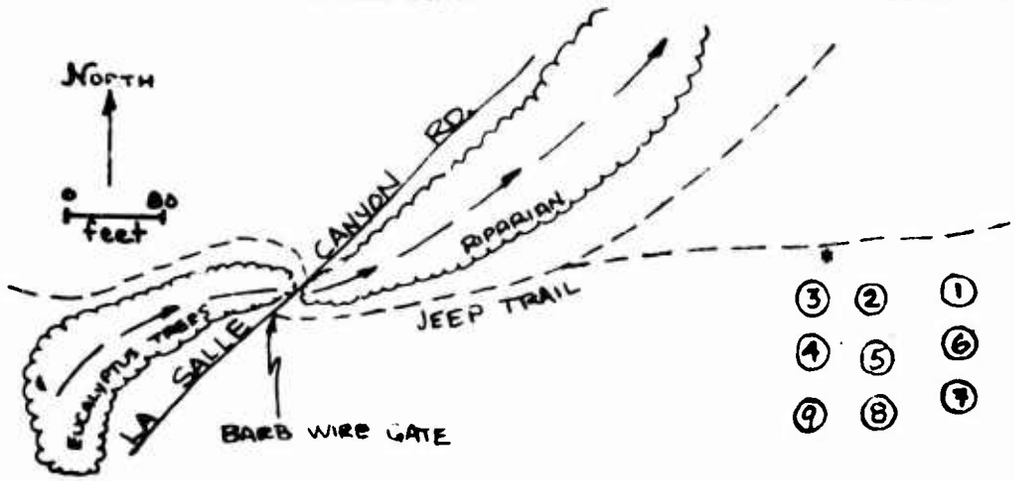
QUADRAT CHARACTERISTICS

Base Map No. 51 Grid Cell Location NB-45.9

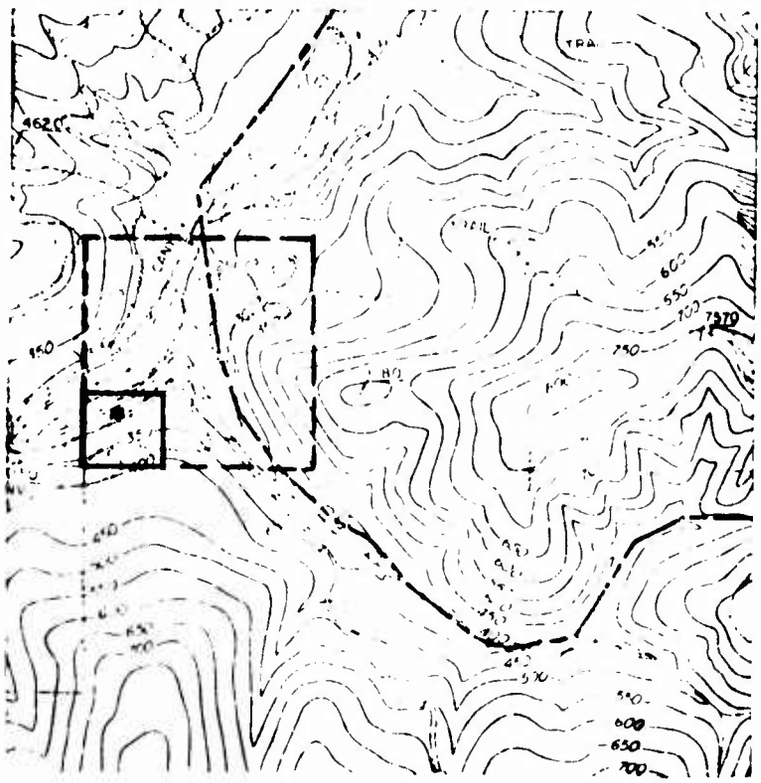
Vegetation Type OAK WOODLAND

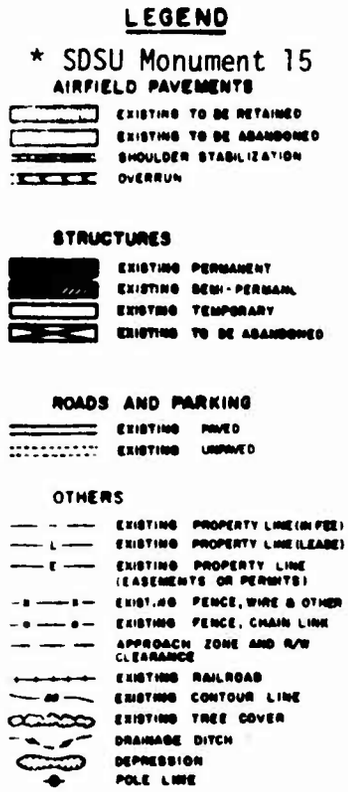
Remarks SPARSE UNDERSTORY; AREA GRAZED

Slope Exposure N Mean Elevation of Quadrat 350'



Reference Directions 1.1 MI N OF ARGUELLO RD TO BARB WIRE GATE; WALK TRAIL FOR 250', TURN RIGHT AND PROCEED UP TRAIL FOR CA. 200'





Contour Interval=5 feet

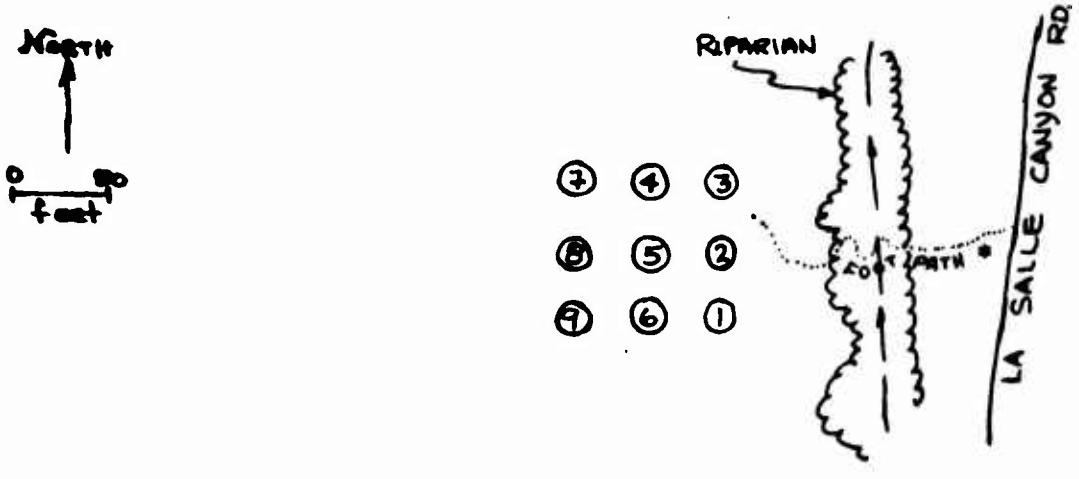
QUADRAT CHARACTERISTICS

Base Map No. 51 **Grid Cell Location** MB-44.4

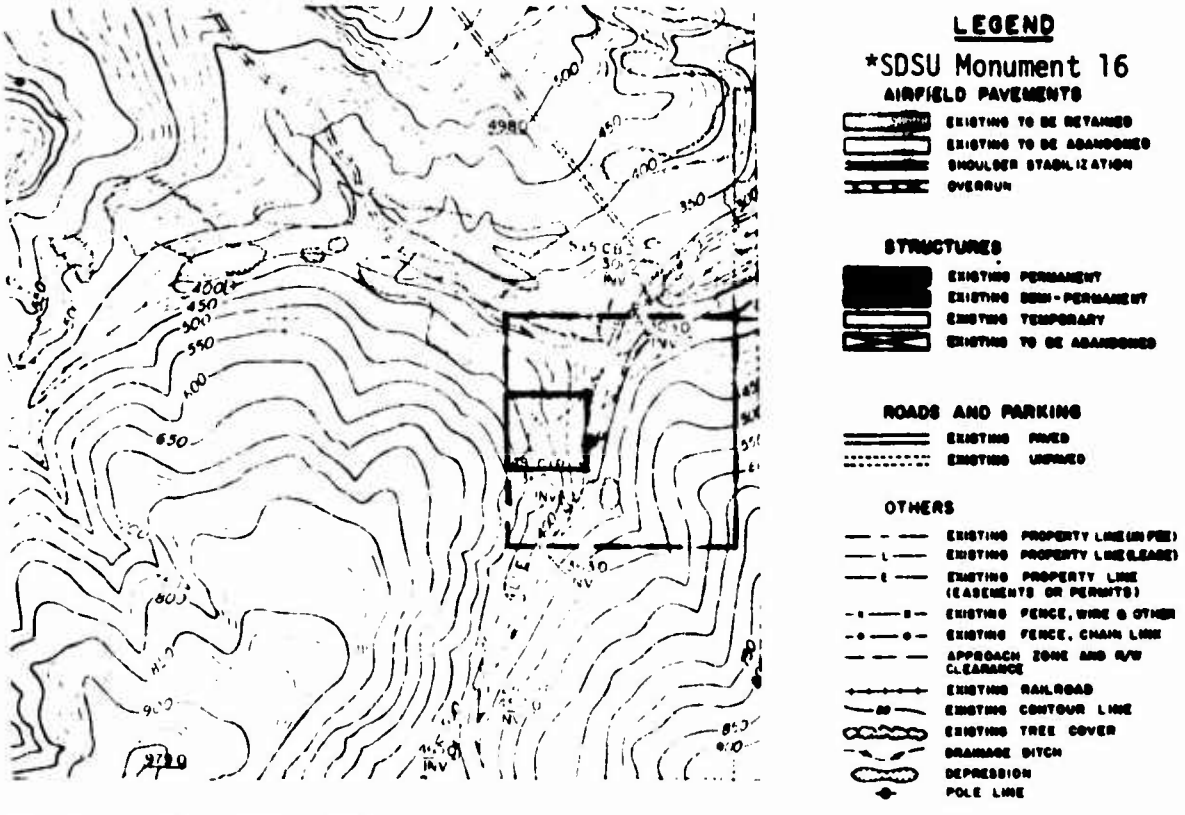
Vegetation Type OAK WOODLAND

Remarks SPARSE UNDERSTORY

Slope Exposure E **Mean Elevation of Quadrat** 400'



Reference Directions 1.0 MI N OF ARGUELLO RD; PASS GATE AT JUNC. AND PROCEED DOWN LASALLE CANNON RD. FOLLOW FOOT PATH FOR CA. 150'



Contour Interval=5 feet

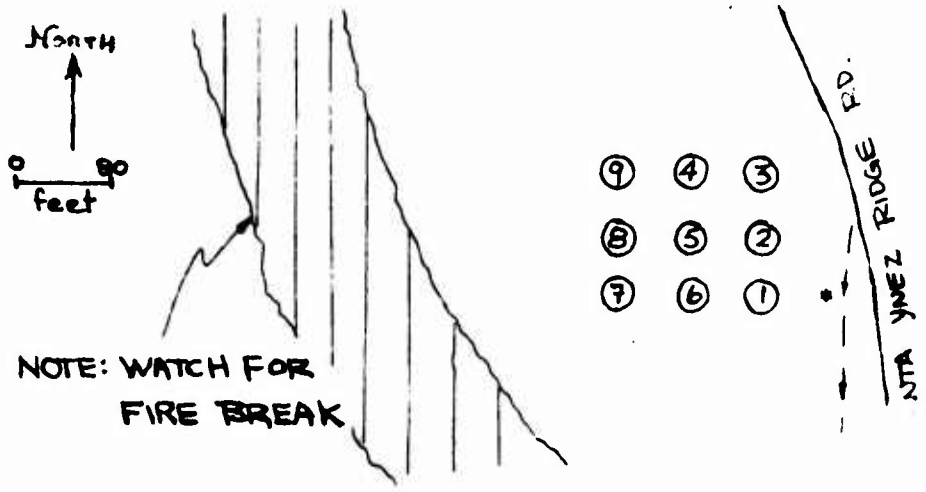
QUADRAT CHARACTERISTICS

Base Map No. 51 Grid Cell Location HB-45.7

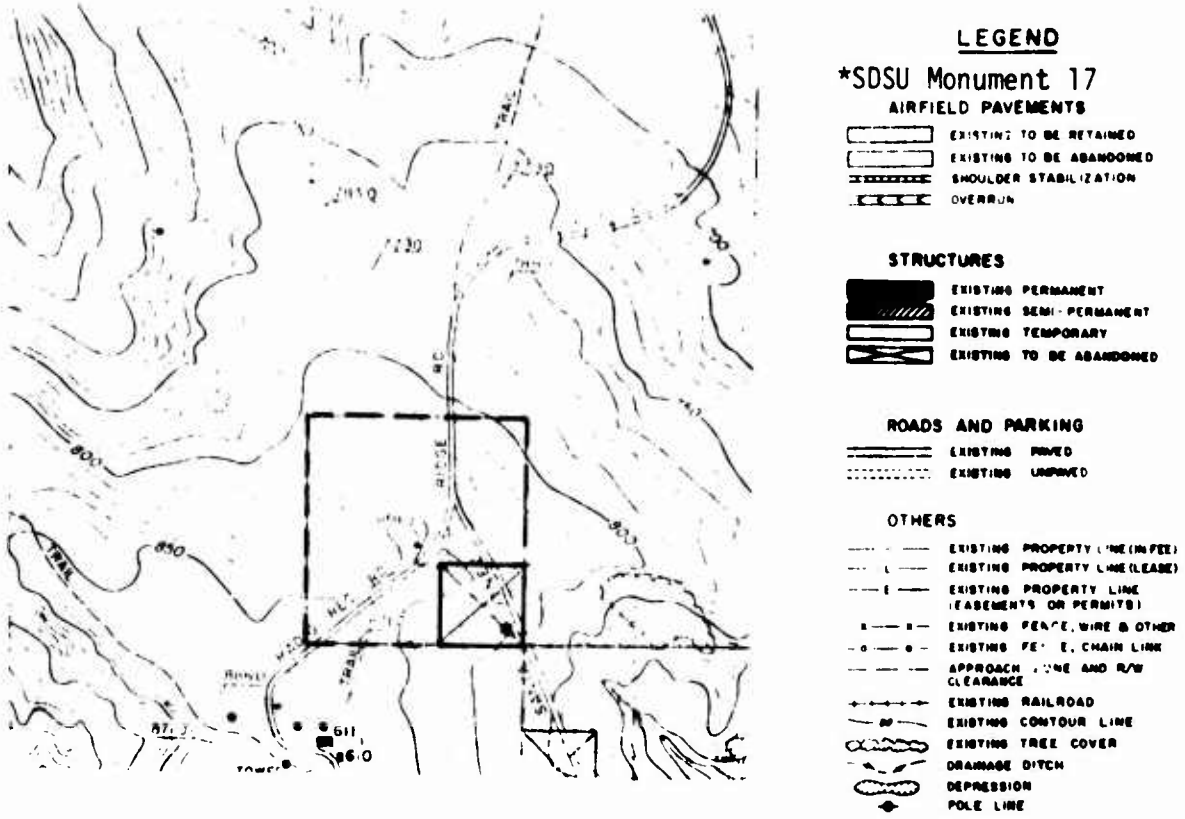
Vegetation Type BISHOP PINE FOREST

Remarks BURNED SITE (BURNED 9 OCT. 1974)

Slope Exposure SE Mean Elevation of Quadrat 825'



Reference Directions 2.9 MI S OF ARGUELLO RD (TO SOUTH GATE) AND 1.1 MI N OF ARGUELLO RD., CA. 0.1 MI S OF RADIO RECEIVER RD.



Contour Interval=5 feet

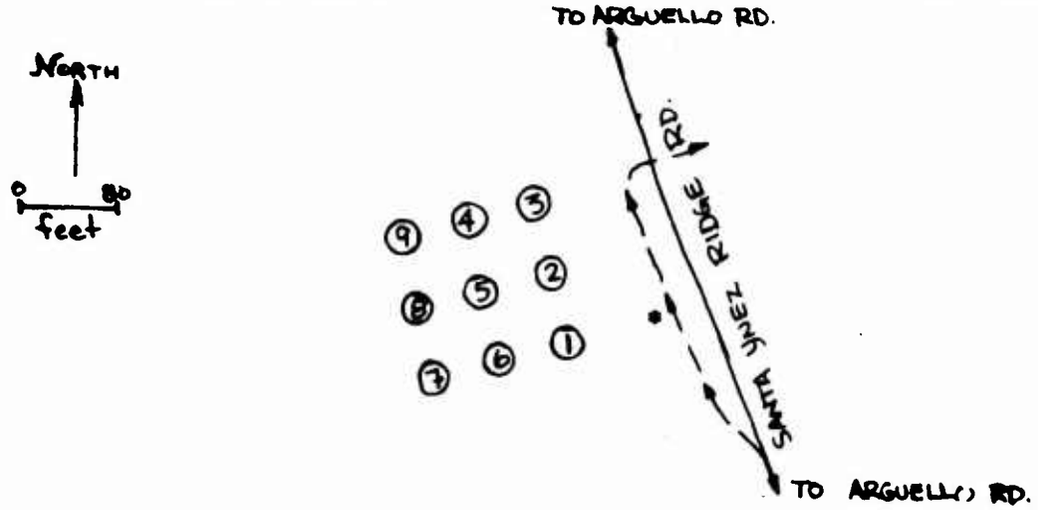
QUADRAT CHARACTERISTICS

Base Map No. 51 Grid Cell Location IB-44.4

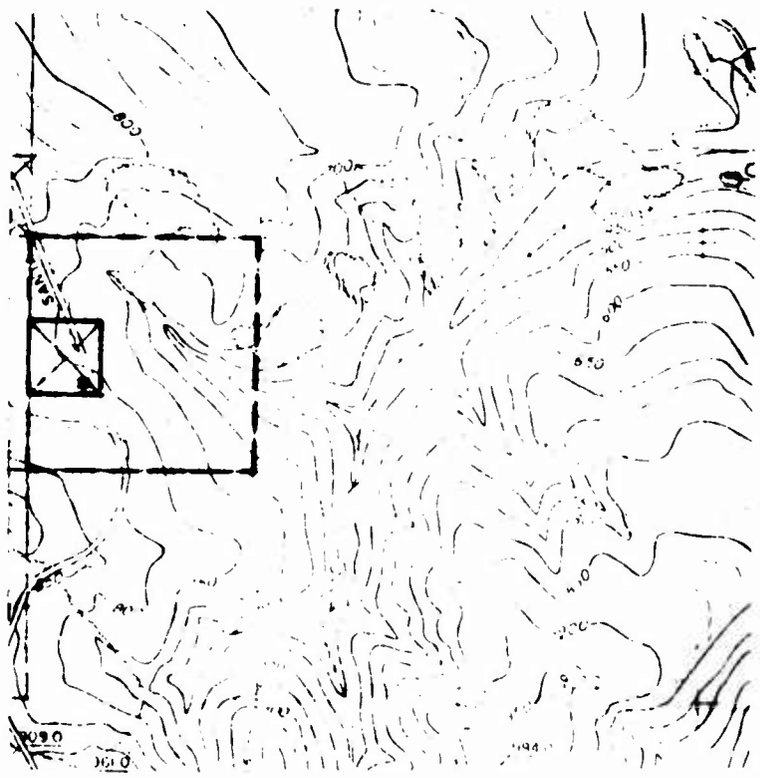
Vegetation Type CHAPARRAL

Remarks DENSE PHASE; EVIDENCE OF PREVIOUS FIRE

Slope Exposure E Mean Elevation of Quadrat 750'



Reference Directions 3.0 MI S OF ARGUELLO RD (TO SOUTH GATE) AND 1.0 MI N OR ARGUELLO RD.; FEW SCATTERED PINES IN QUADRAT.



LEGEND

*SDSU Monument 18

AIRFIELD PAVEMENTS
- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES
- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING
- EXISTING PAVED
- EXISTING UNPAVED

OTHERS
- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

Contour Interval=5 feet

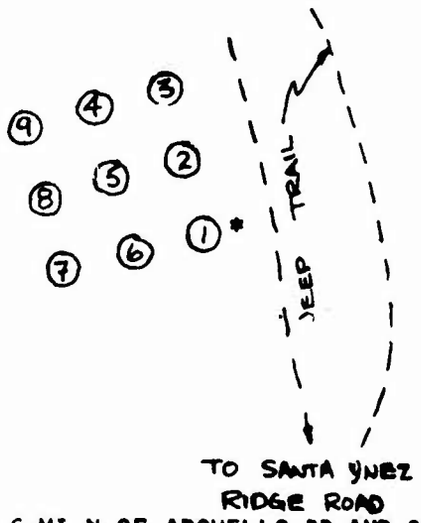
QUADRAT CHARACTERISTICS

Base Map No. 51 Grid Cell Location HB-43.4

Vegetation Type BISHOP PINE FOREST

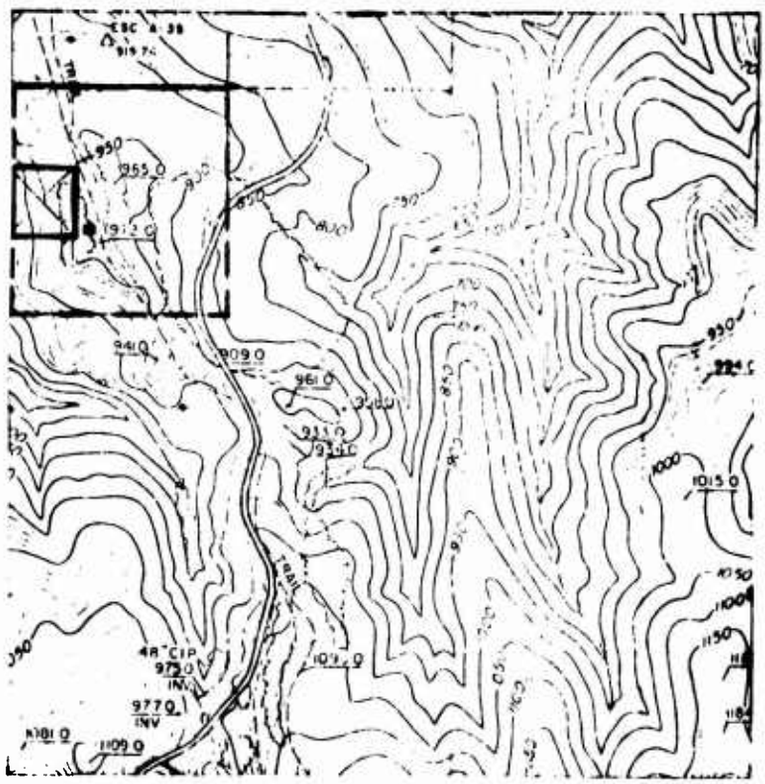
Remarks SPARSE PHASE

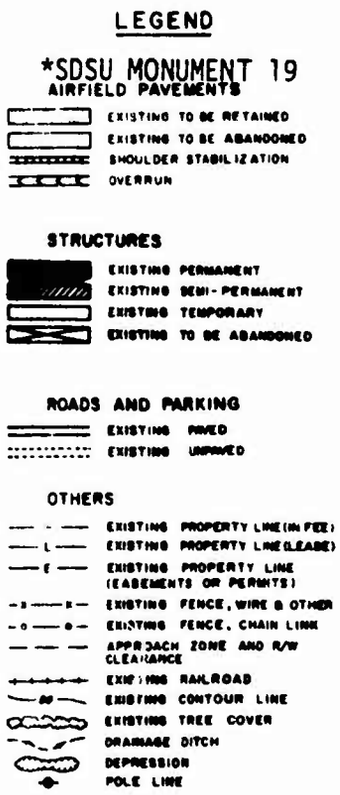
Slope Exposure W Mean Elevation of Quadrat 925'



NOTE: WATCH FOR DITCH ON TRAIL TO QUADRAT; CAN BE ROUGH.

Reference Directions JEEP TRAIL 0.6 MI N OF ARGUELLO RD AND 3.4 MI S OF ARGUELLO RD (TO SOUTH GATE). QUADRAT 0.1 MI N SANTA YNEZ RIDGE RD.





Contour Interval=5 feet

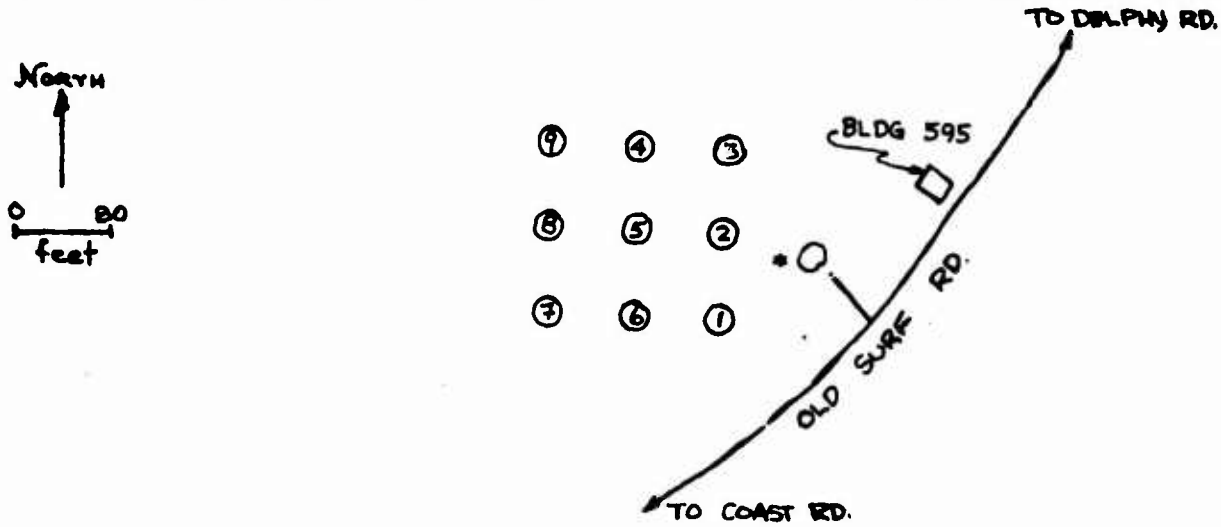
QUADRAT CHARACTERISTICS

Base Map No. 53 Grid Cell Location JA-39,8

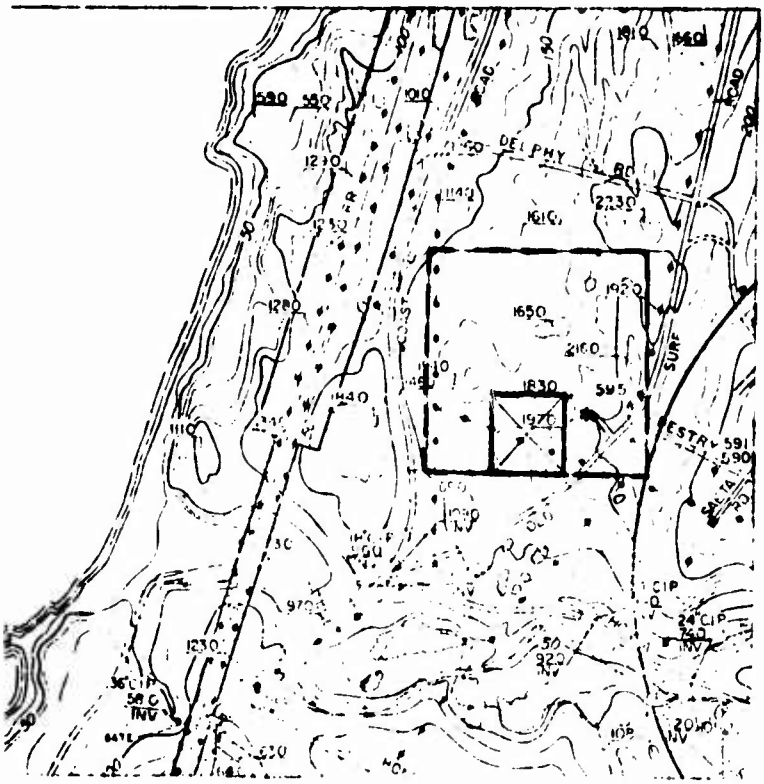
Vegetation Type COASTAL SAGE SCRUB DUNE, STABILIZED

Remarks DENSE PHASE

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 195'



Reference Directions 0.2 MI NE OF COAST RD, AND 0.2 MI SW OF DELPHY RD. TRAVEL SIDE ROAD FOR CA. 100 TO QUADRAT



LEGEND

*SDSU Monument 21

AIRFIELD PAVEMENTS
- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES
- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING
- EXISTING PAVED
- EXISTING UNPAVED

OTHERS
- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

Contour Interval=5 feet

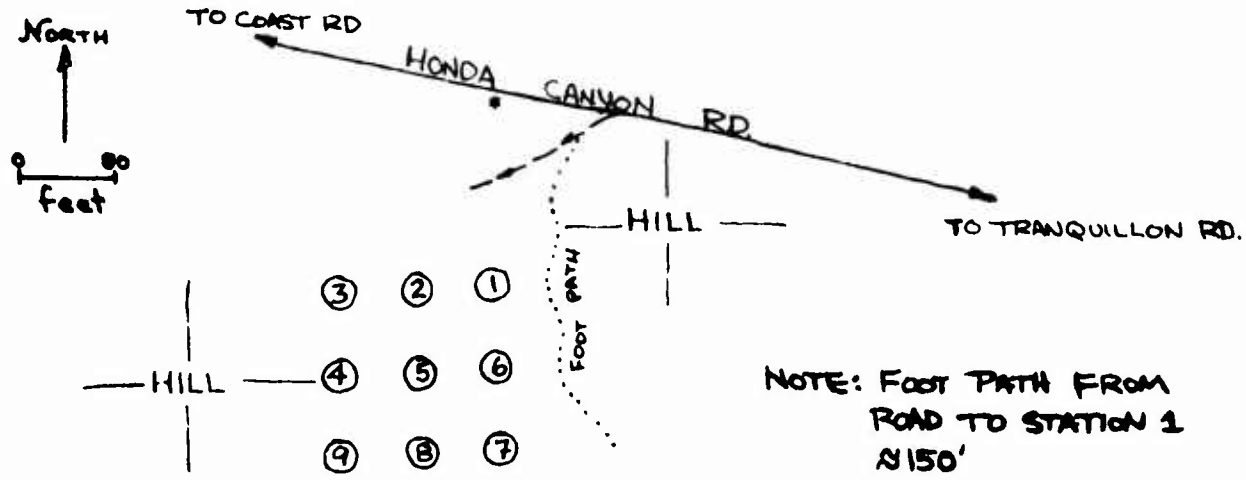
QUADRAT CHARACTERISTICS

Base Map No. 53 Grid Cell Location KA-37.3

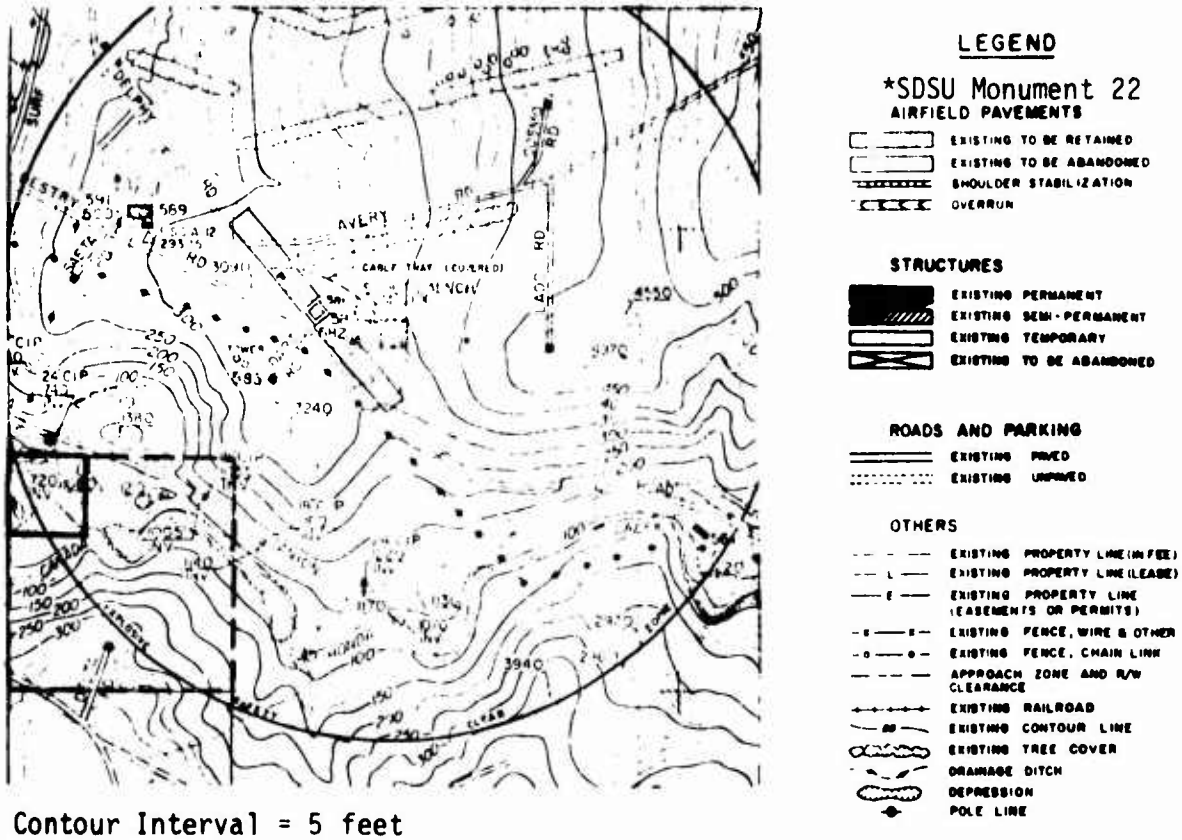
Vegetation Type RIPARIAN WOODLAND

Remarks SPARSE PHASE WITH COASTAL SAGE SCRUB INFLUENCE

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 75'



Reference Directions 0.3 MI E OF COAST RD. QUADRAT BORDERED BY HILL ON EAST AND WEST; AREA WITH FEW WILLOWS; WET SOIL SCRUB PRESENT.



Contour Interval = 5 feet

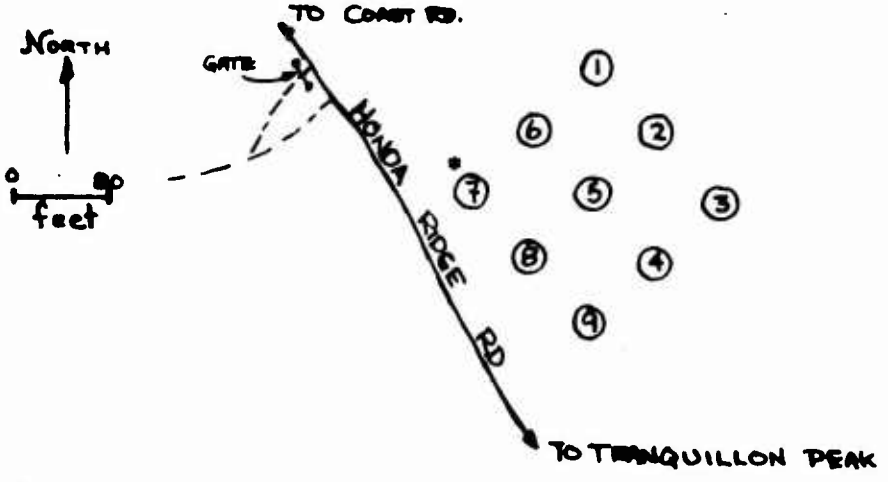
QUADRAT CHARACTERISTICS

Base Map No. 53 Grid Cell Location KA-36.7

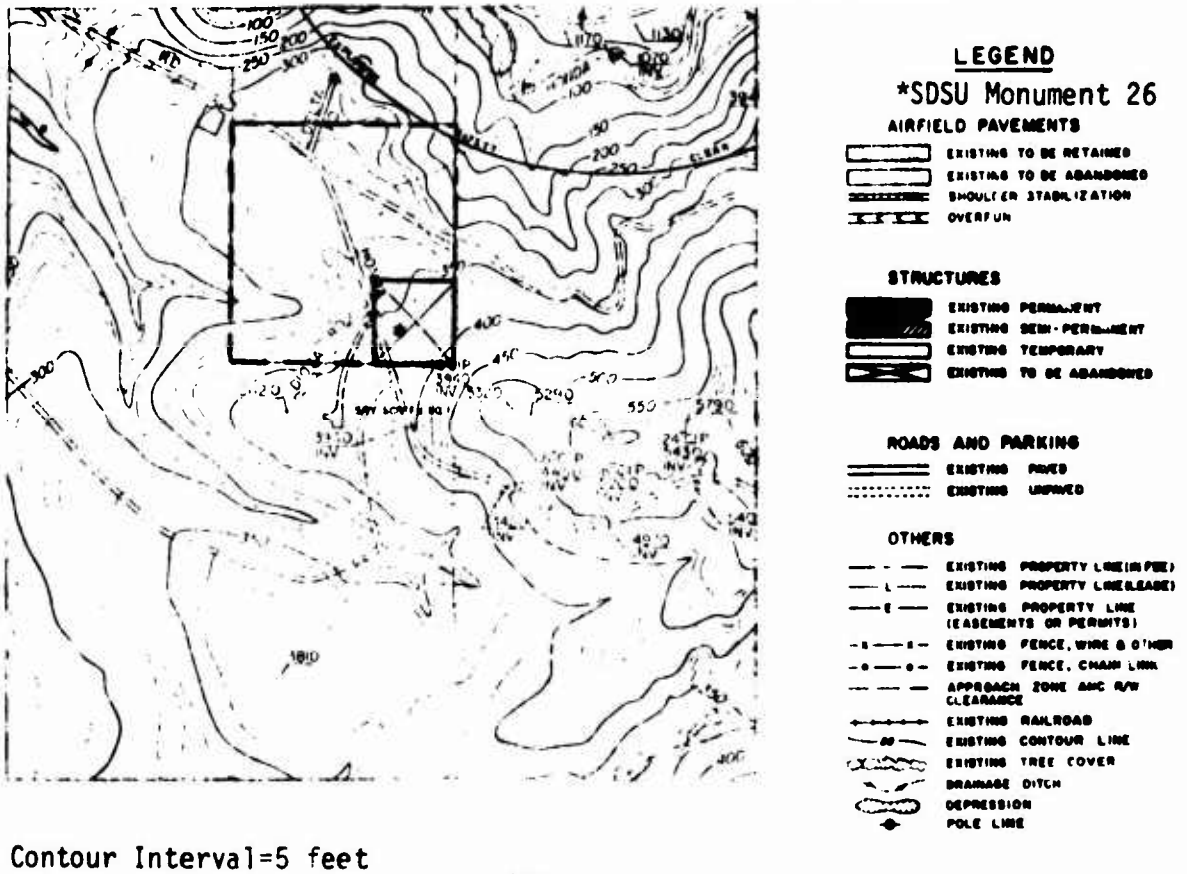
Vegetation Type COASTAL SAGE SCRUB

Remarks NORMAL PHASE, PREDOMINANTLY ARTEMISIA CALIFORNICA

Slope Exposure NW Mean Elevation of Quadrat 375'



Reference Directions 0.6 MI E OF COAST RD, AND 5.0 MI W OF TRANQUILLON PEAK; WATCH FOR CATTLE CROSSING AND GATE.



Contour Interval=5 feet

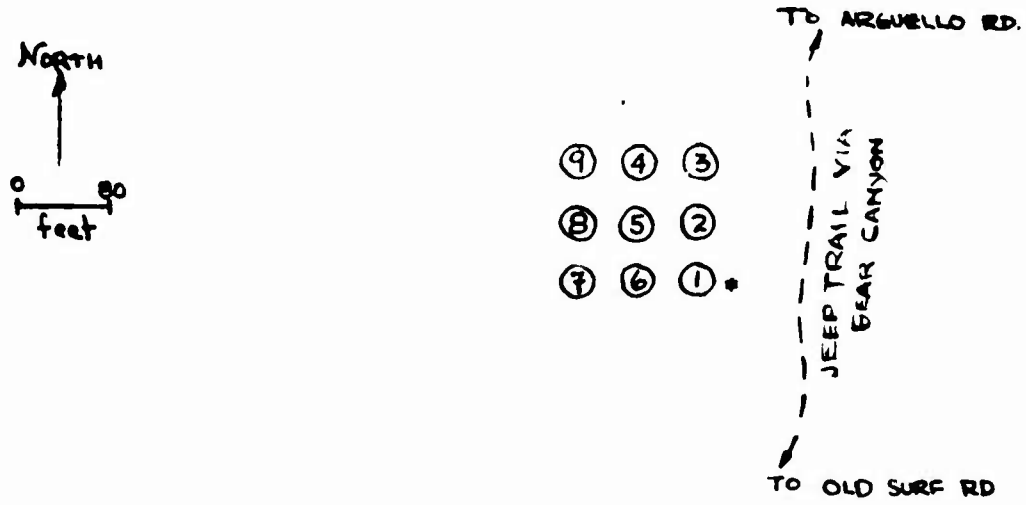
QUADRAT CHARACTERISTICS

Base Map No. 54 Grid Cell Location BB-39.4

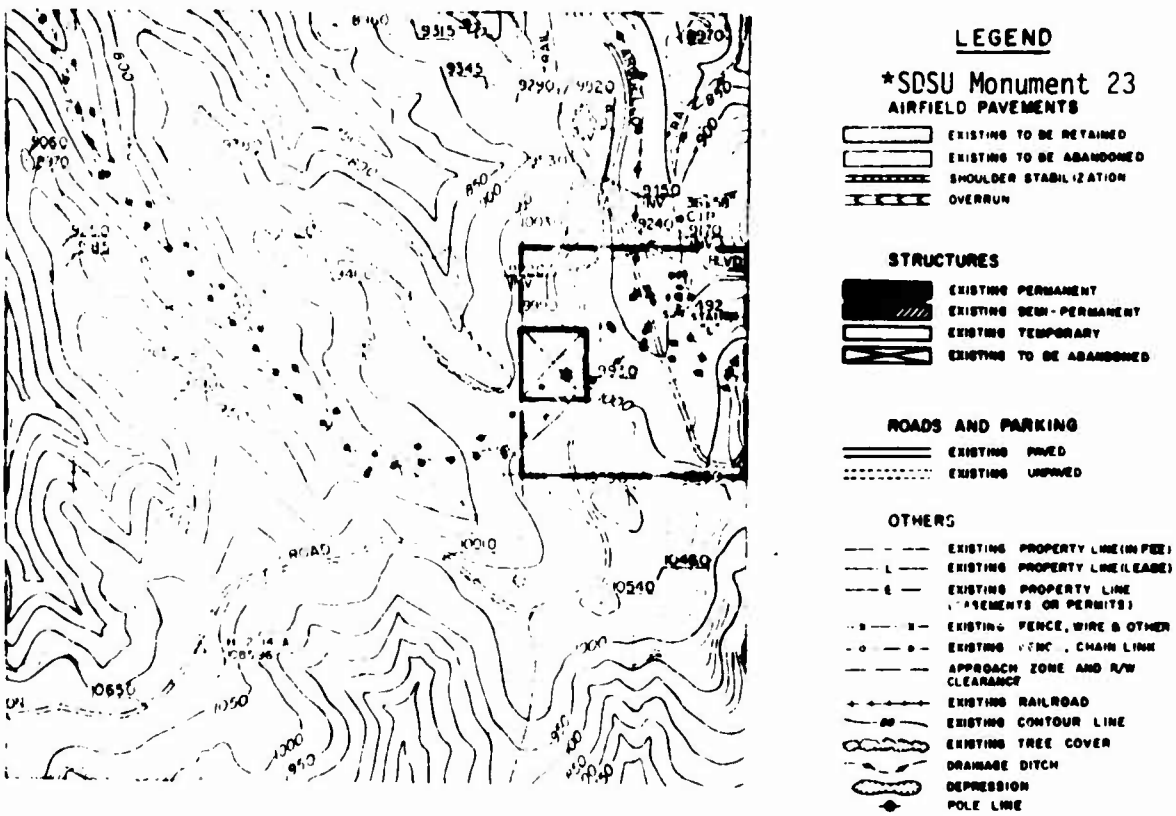
Vegetation Type CHAPARRAL

Remarks DENSE PHASE

Slope Exposure W Mean Elevation of Quadrat 975'



Reference Directions 0.1 AND 0.2 MI SOUTH OF SPRING CANYON RD AND ARGUELLO RD, RESPECTIVELY, ON WEST SIDE OF TRAIL



Contour Interval = 5 feet

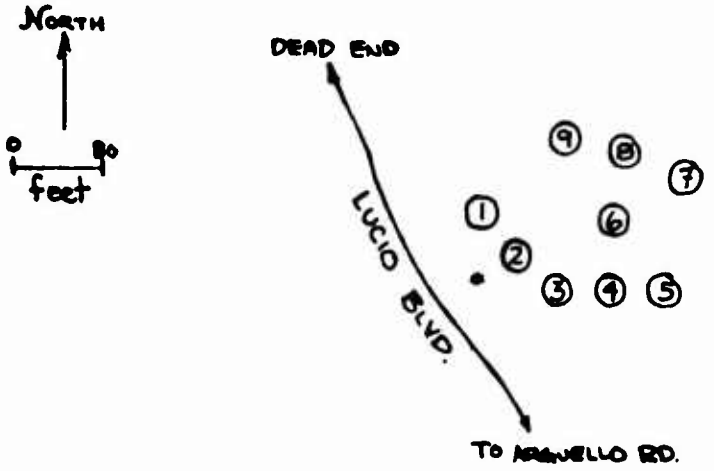
QUADRAT CHARACTERISTICS

Base Map No. 55 Grid Cell Location FB-40.8

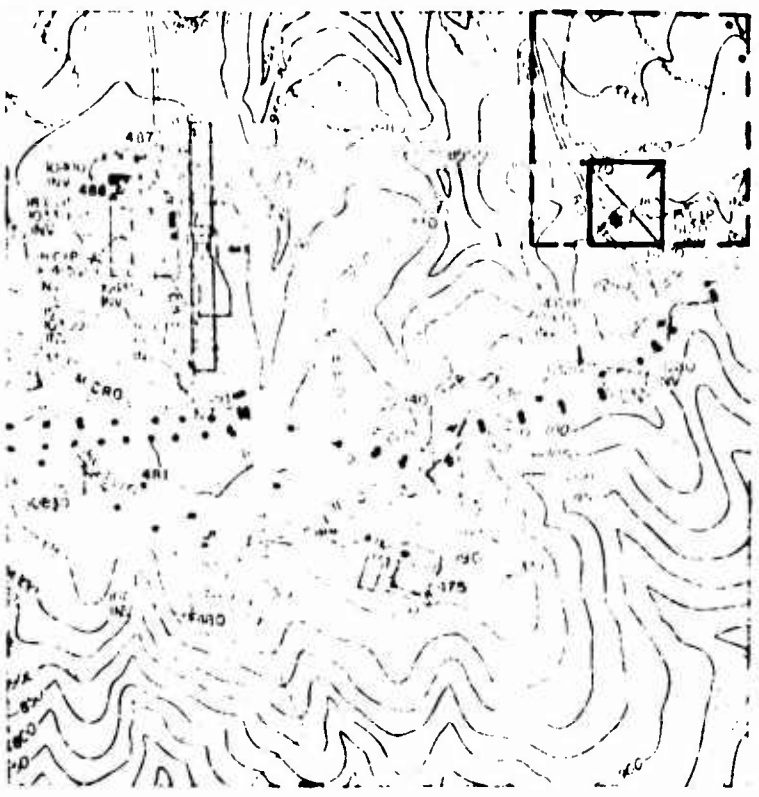
Vegetation Type BISHOP PINE FOREST

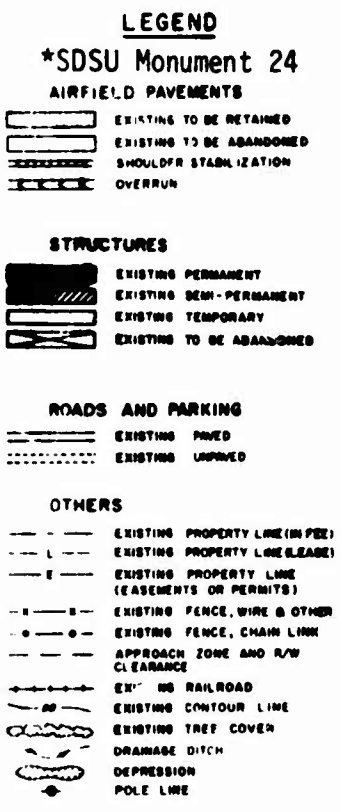
Remarks NORMAL PHASE

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 1105'



Reference Directions QUADRAT CA. 300' N OF ARGUELLO RD





Contour Interval=5 feet

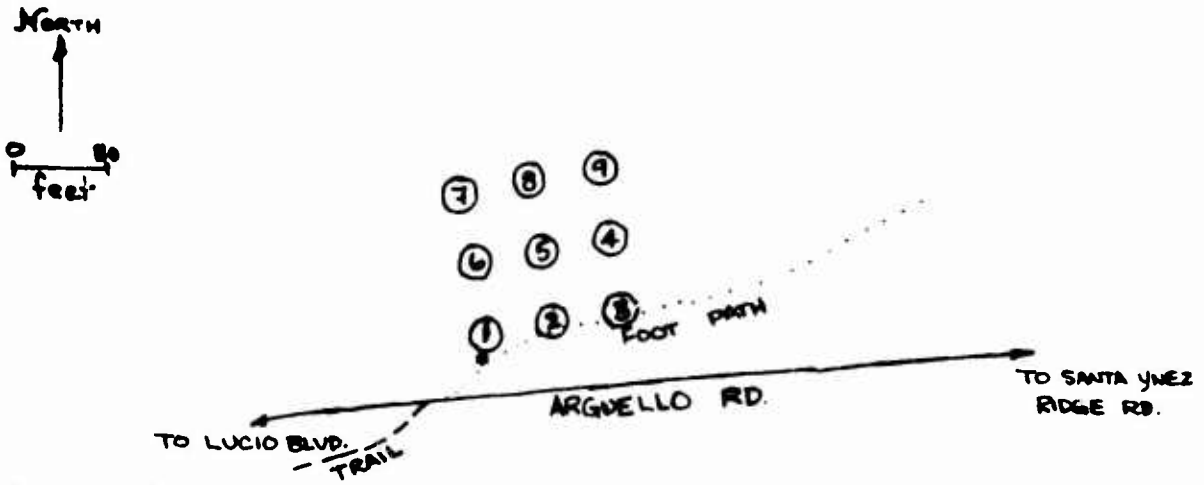
QUADRAT CHARACTERISTICS

Base Map No. 55 Grid Cell Location GB-40.8

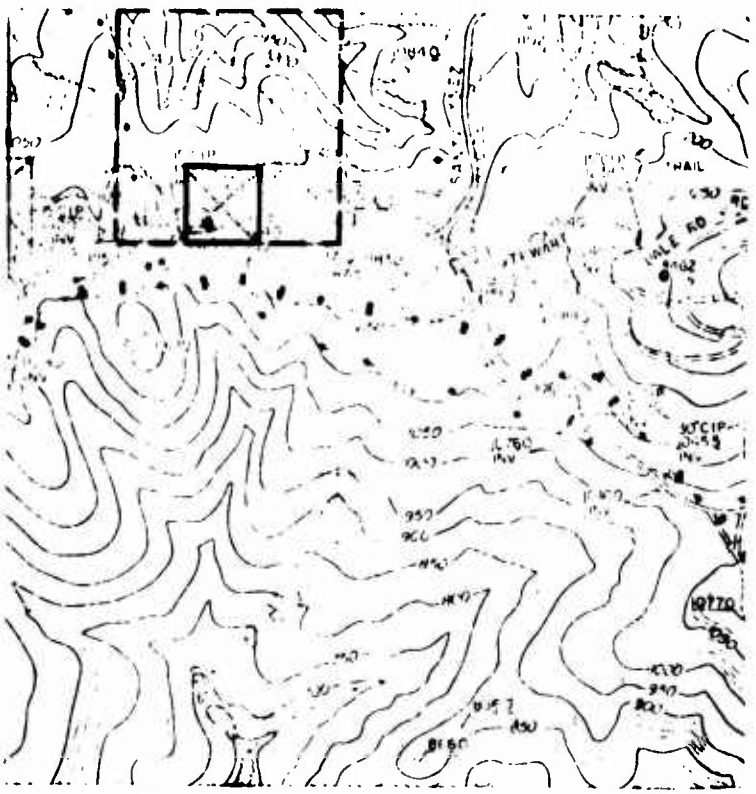
Vegetation Type BISHOP PINE FOREST

Remarks SPARSE PHASE

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 1100'



Reference Directions 0.1 MI E LUCIO BLVD AND 0.2 MI W OF SANTA YNEZ RIDGE RD.



LEGEND

*SDSU Monument 25

AIRFIELD PAVEMENTS

EXISTING TO BE RETAINED
EXISTING TO BE ABANDONED
SHOULDER STABILIZATION
OVERRUN

STRUCTURES

EXISTING PERMANENT
EXISTING SEMI-PERMANENT
EXISTING TEMPORARY
EXISTING TO BE ABANDONED

ROADS AND PARKING

EXISTING PAVED
EXISTING UNPAVED

OTHERS

EXISTING PROPERTY LINE (IN FEE)
EXISTING PROPERTY LINE (LEASE)
EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
EXISTING FENCE, WIRE & OTHER
EXISTING FENCE, CHAIN LINK
APPROACH ZONE AND R/W CLEARANCE
EXISTING RAILROAD
EXISTING CONTOUR LINE
EXISTING TREE COVER
DRAINAGE DITCH
DEPRESSION
POLE LINE

Contour Interval = 5 feet

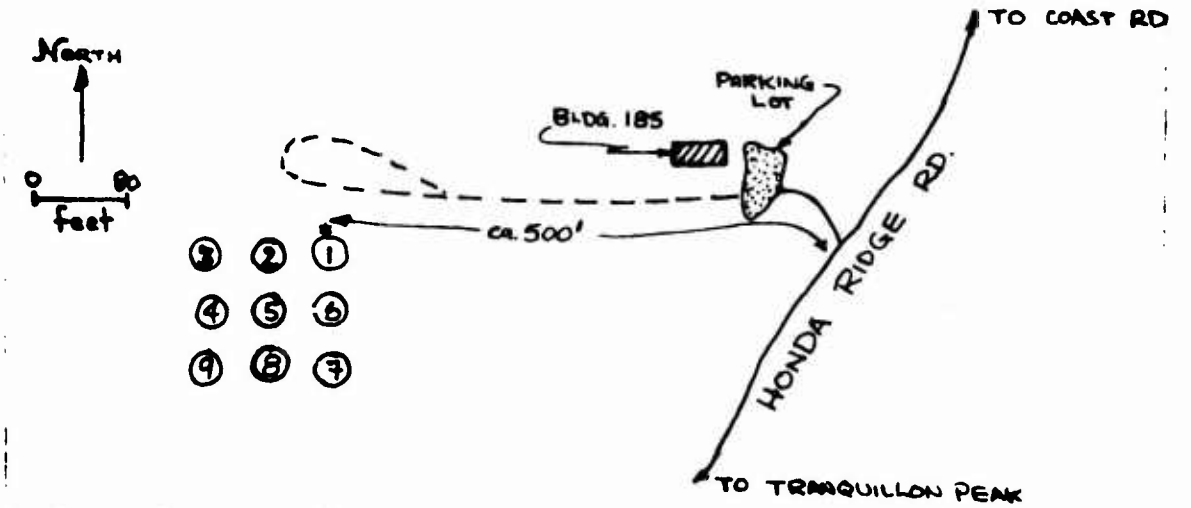
QUADRAT CHARACTERISTICS

Base Map No. 59 Grid Cell Location EB-29.8

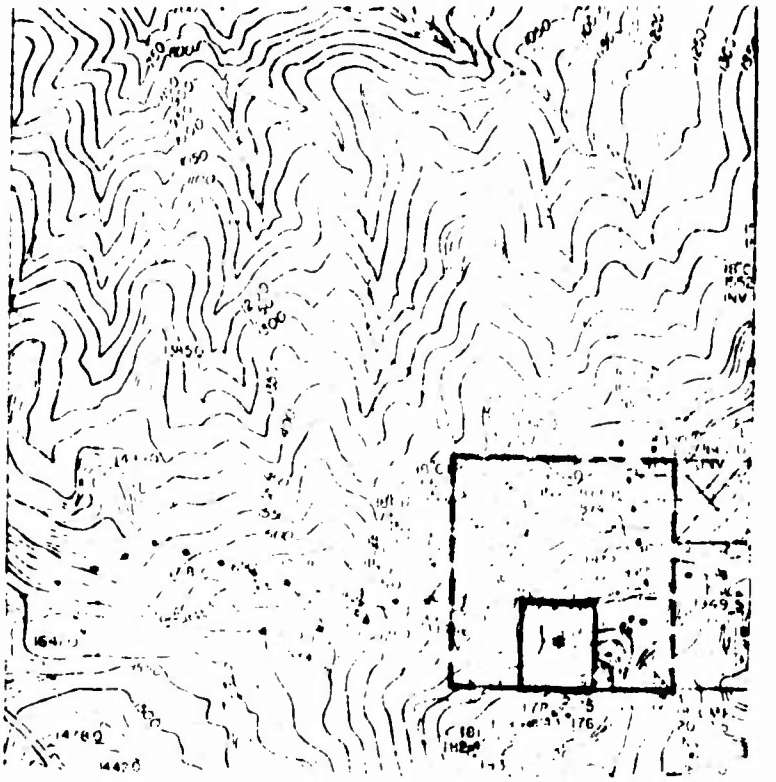
Vegetation Type TANOAK FOREST

Remarks DENSE PHASE; DENSE UNDERSTORY

Slope Exposure NNE Mean Elevation of Quadrat 1985'



Reference Directions 0.2 MI UP TO TRANQUILLON PEAK AND 5.4 MI E OF COAST RD.; FIRST TURN-OFF ON LEFT FROM PEAK.



LEGEND

*SDSU Monument 27

AIRFIELD PAVEMENTS

EXISTING TO BE RETAINED
EXISTING TO BE ABANDONED
SHOULDER STABILIZATION
OVERRUN

STRUCTURES

EXISTING PERMANENT
EXISTING SEMI-PERMANENT
EXISTING TEMPORARY
EXISTING TO BE ABANDONED

ROADS AND PARKING

EXISTING PAVED
EXISTING UNPAVED

OTHERS

EXISTING PROPERTY LINE (IN FEE)
EXISTING PROPERTY LINE (LEASE)
EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
EXISTING FENCE, WIRE & OTHER
EXISTING FENCE, CHAIN LINK
APPROACH ZONE AND R/W CLEARANCE
EXISTING RAILROAD
EXISTING CONTOUR LINE
EXISTING TREE COVER
DRAINAGE DITCH
DEPRESSION
POLE LINE

Contour Interval=5 feet

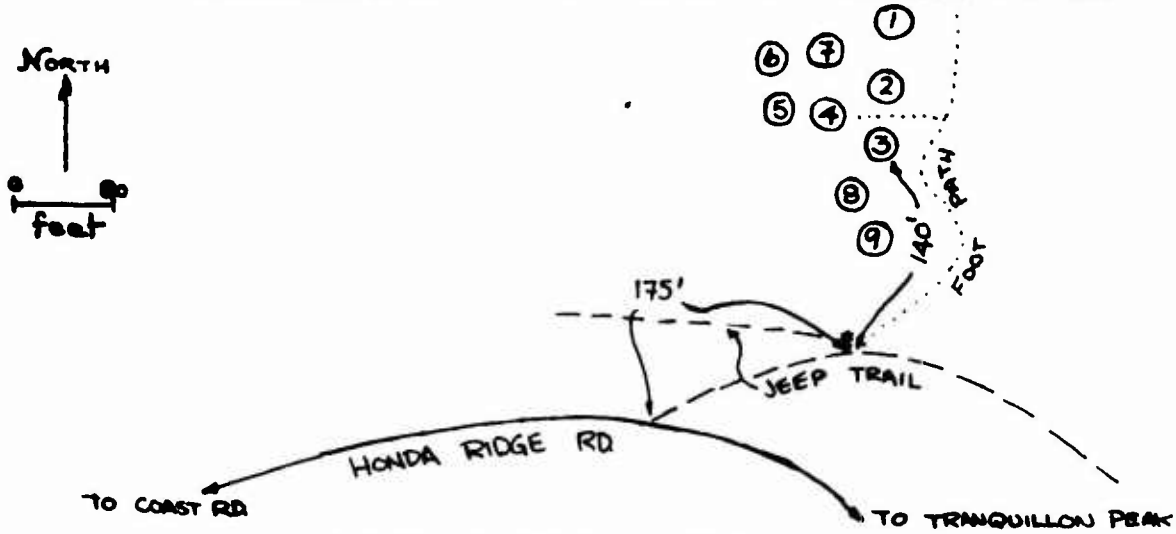
QUADRAT CHARACTERISTICS

Base Map No. 59 Grid Cell Location FB-29.3

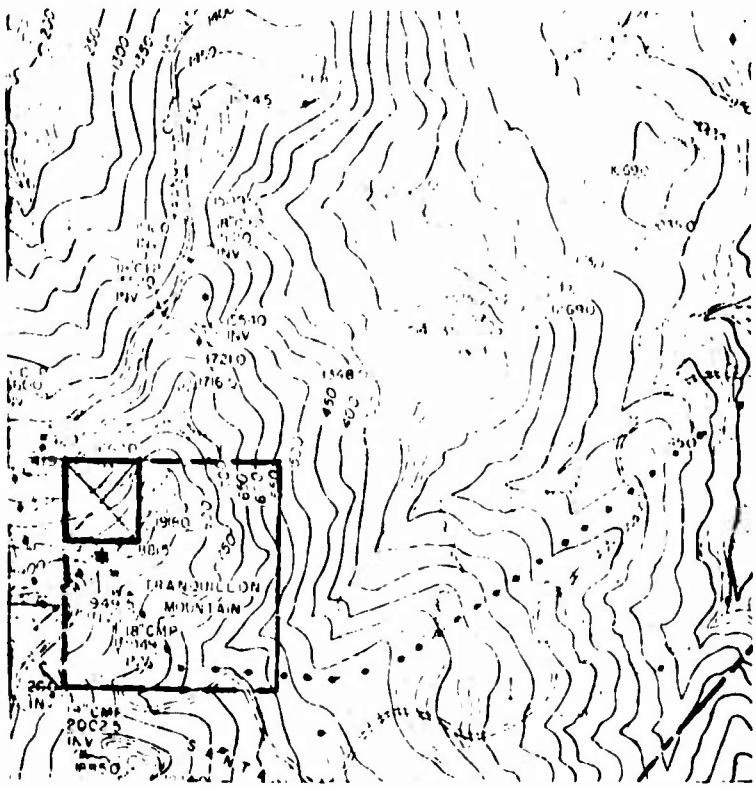
Vegetation Type TANOAK FOREST

Remarks DENSE PHASE; DENSE UNDERSTORY

Slope Exposure NW Mean Elevation of Quadrat 1800'



Reference Directions 5.3 MI E OF COAST RED AND 0.3 MI FROM TRANQUILLON PEAK ON SECOND SWITCHBACK DOWN PEAK. FOLLOW FOOT PATH UP-HILL



Contour Interval=5 feet

LEGEND

*SDSU Monument 28

AIRFIELD PAVEMENTS
- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES
- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING
- EXISTING PAVED
- EXISTING UNPAVED

OTHERS
- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

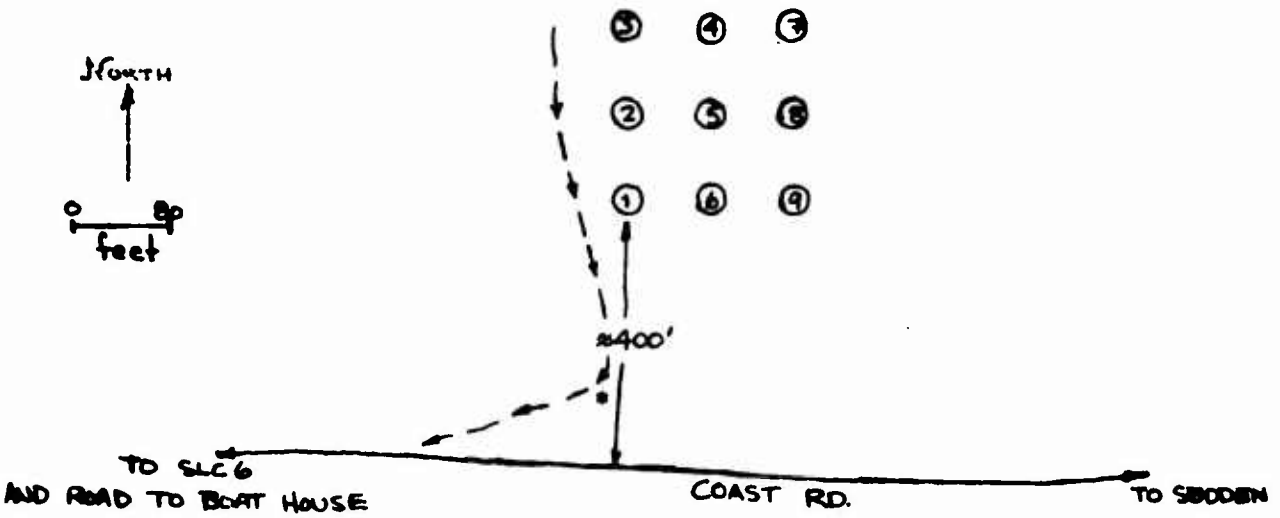
QUADRAT CHARACTERISTICS

Base Map No. 61 Grid Cell Location SA-21.4

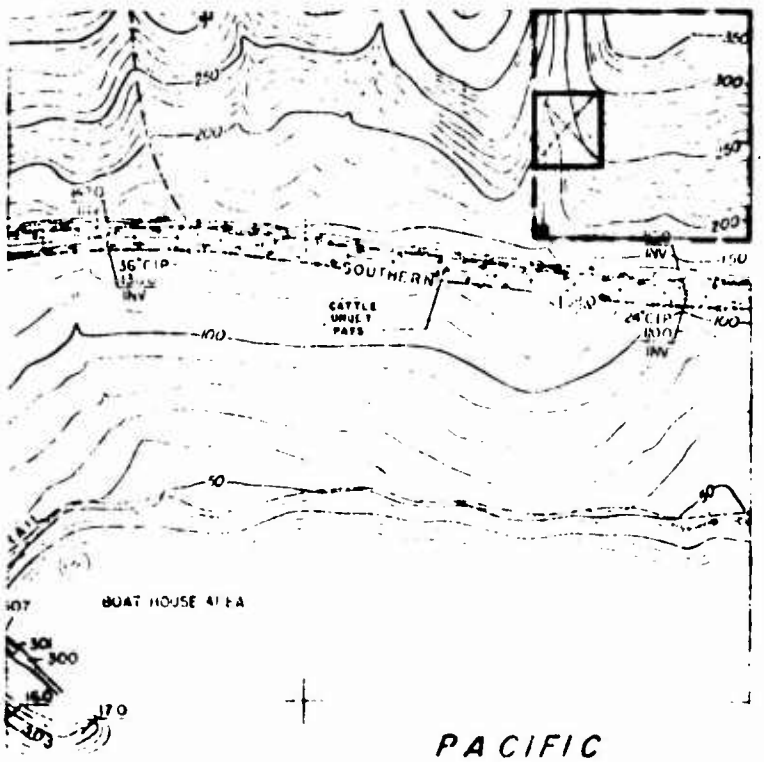
Vegetation Type COASTAL SAGE SCRUB

Remarks XERIC PHASE, PREDOMINANTLY SALVIA LEUCOPHYLLA

Slope Exposure W Mean Elevation of Quadrat 225'



Reference Directions 0.5 MI E OF ROAD TO BOAT HOUSE OR 5.1 MI E OF SLC 6 AND 5.0 MI W OF SUDDEN RANCH; STEEP WEST SLOPE



Contour Interval = 5 feet

LEGEND

* SDSU Monument 29

AIRFIELD PAVEMENTS
- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES
- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING
- EXISTING PAVED
- EXISTING UNPAVED

OTHERS
- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

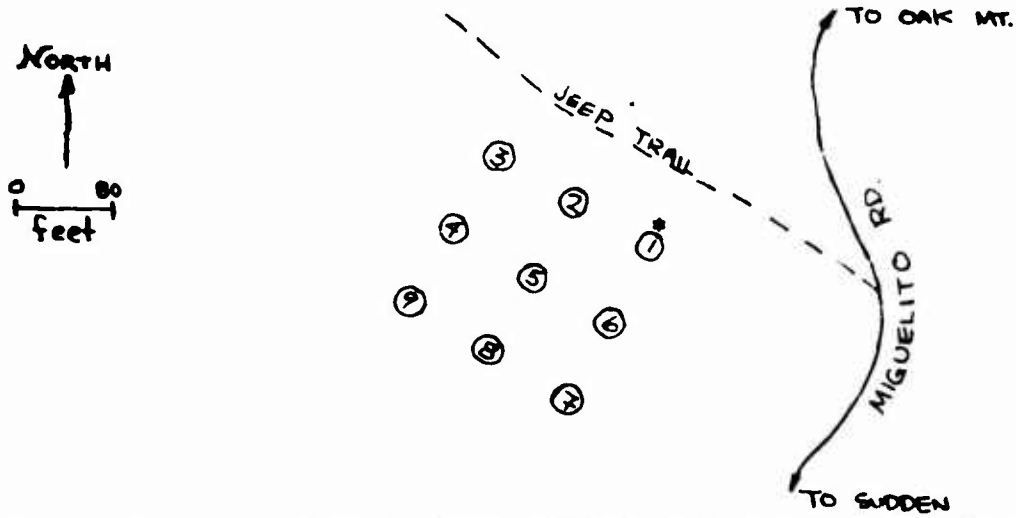
QUADRAT CHARACTERISTICS

Base Map No. 62 Grid Cell Location NB-19.7

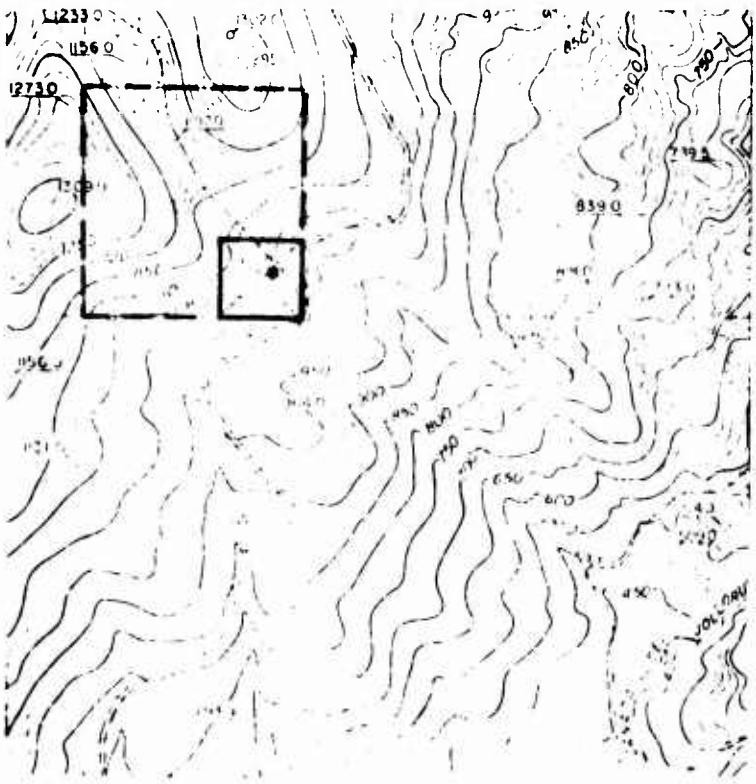
Vegetation Type ANNUAL GRASSLAND

Remarks ROCK OUTCROPPINGS PRESENT

Slope Exposure SE Mean Elevation of Quadrat 1050'



Reference Directions ROCKY GRAZED QUADRAT. 1.9 MI N OF SUDDEN RANCH (=COAST RD); CA. 200' UP TRAIL FROM MIGUELITO RANCH.



LEGEND

*SDSU Monument 31

AIRFIELD PAVEMENTS
- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES
- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING
- EXISTING PAVED
- EXISTING UNPAVED

OTHERS
- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

Contour Interval=5 feet

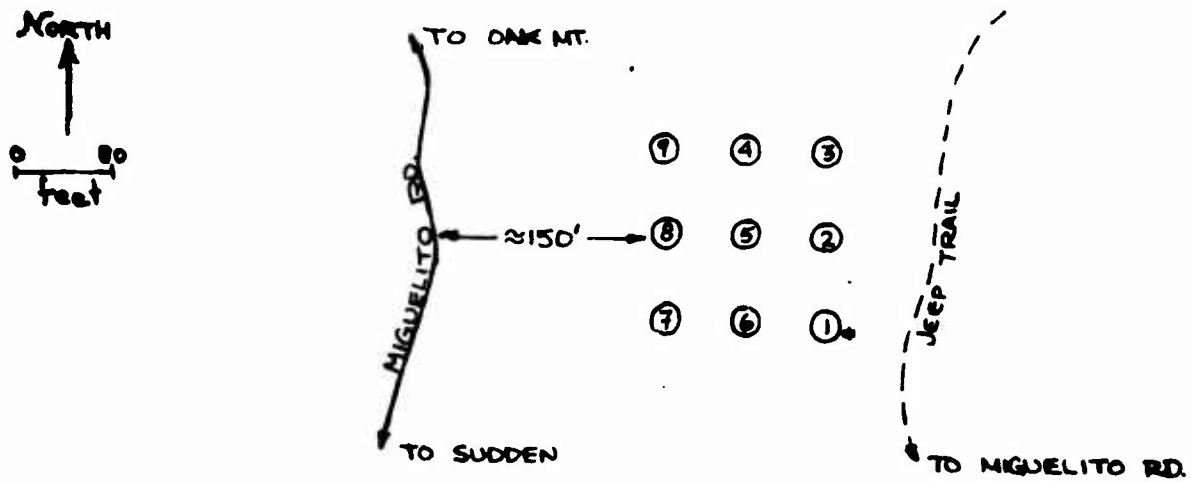
QUADRAT CHARACTERISTICS

Base Map No. 62 Grid Cell Location OB-21.7

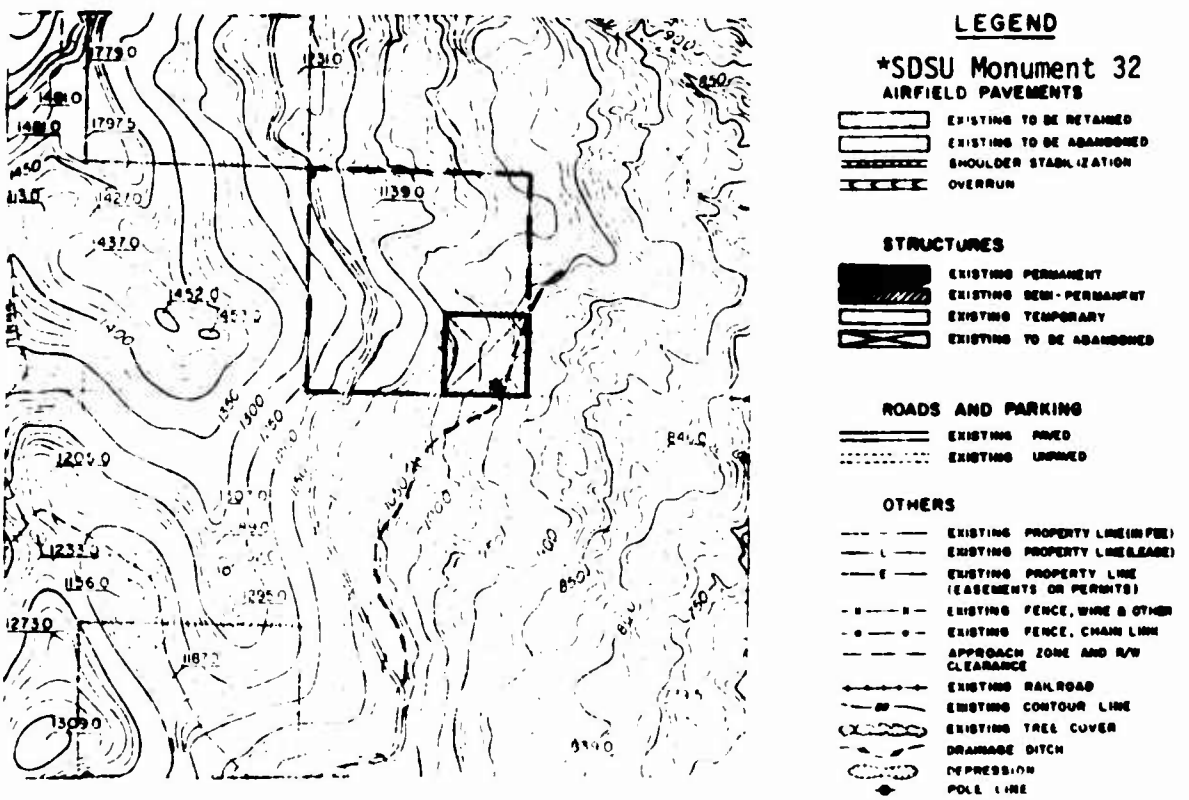
Vegetation Type COASTAL SAGE SCRUB

Remarks XERIC PHASE

Slope Exposure E Mean Elevation of Quadrat 975'



Reference Directions 2.4 MI N OF COAST RD. AND 1.5 MI S OF MIGUELITO GATE; 0.3 MI FROM MIGUELITO RD TO QUADRAT VIA JEEP TRAIL



Contour Interval=5 feet

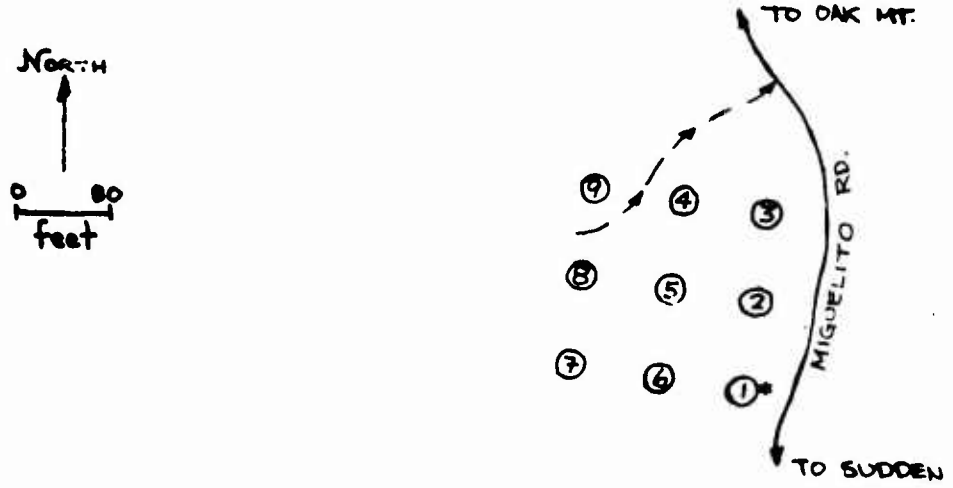
QUADRAT CHARACTERISTICS

Base Map No. 62 Grid Cell Location NB-22.1

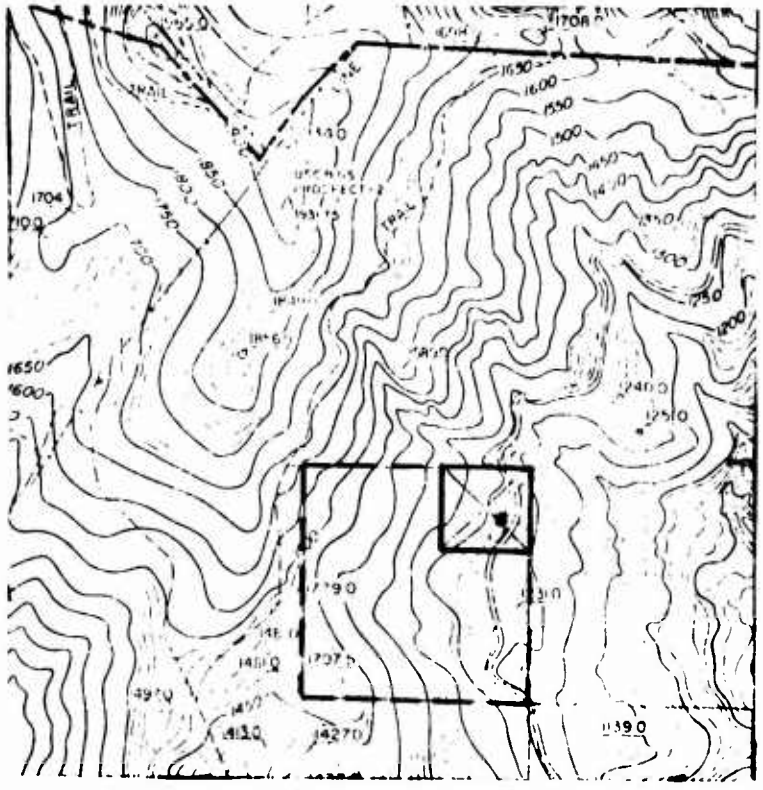
Vegetation Type COASTAL SAGE SCRUB

Remarks XERIC PHASE

Slope Exposure ESE Mean Elevation of Quadrat 1250'



Reference Directions 2.7 MI N OF COAST RD, AND 1.2 MI S OF MIGUELITO GATE.



LEGEND

*SDSU Monument 33

AIRFIELD PAVEMENTS
- EXISTING TO BE RETAINED
- EXISTING TO BE ABANDONED
- SHOULDER STABILIZATION
- OVERRUN

STRUCTURES
- EXISTING PERMANENT
- EXISTING SEMI-PERMANENT
- EXISTING TEMPORARY
- EXISTING TO BE ABANDONED

ROADS AND PARKING
- EXISTING PAVED
- EXISTING UNPAVED

OTHERS
- EXISTING PROPERTY LINE (IN FEE)
- EXISTING PROPERTY LINE (LEASE)
- EXISTING PROPERTY LINE (EASEMENTS OR PERMITS)
- EXISTING FENCE, WIRE & OTHER
- EXISTING FENCE, CHAIN LINK
- APPROACH ZONE AND R/W CLEARANCE
- EXISTING RAILROAD
- EXISTING CONTOUR LINE
- EXISTING TREE COVER
- DRAINAGE DITCH
- DEPRESSION
- POLE LINE

Contour Interval = 5 feet

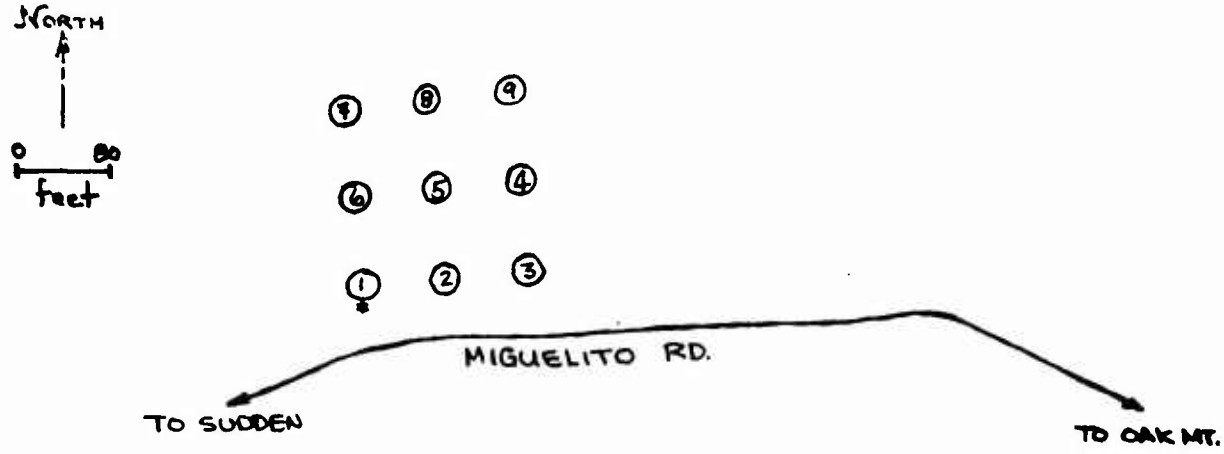
QUADRAT CHARACTERISTICS

Base Map No. 62 Grid Cell Location PB-24.5

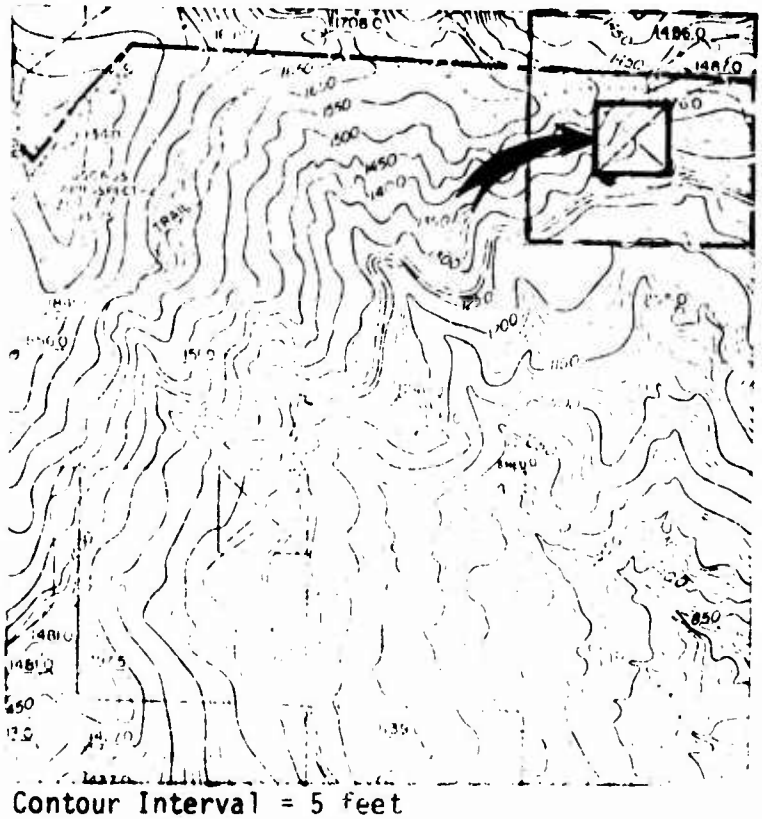
Vegetation Type COASTAL SAGE SCRUB

Remarks NORMAL PHASE

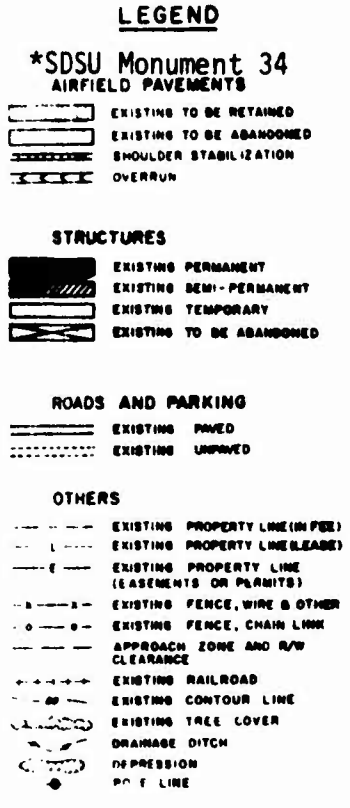
Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 1350'



Reference Directions 3.4 MI NORTH OF COAST RD AND 0.5 SE OF MIGUELITO GATE. STEEP SLOPE ON NORTH SIDE FACING CANADA DEL JOLLORU



Contour Interval = 5 feet



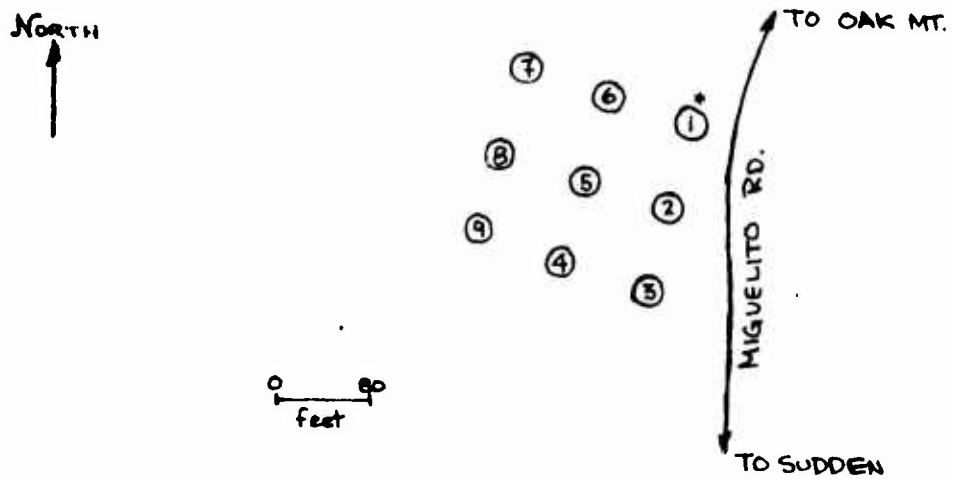
QUADRAT CHARACTERISTICS

Base Map No. 64 Grid Cell Location MB-15.8

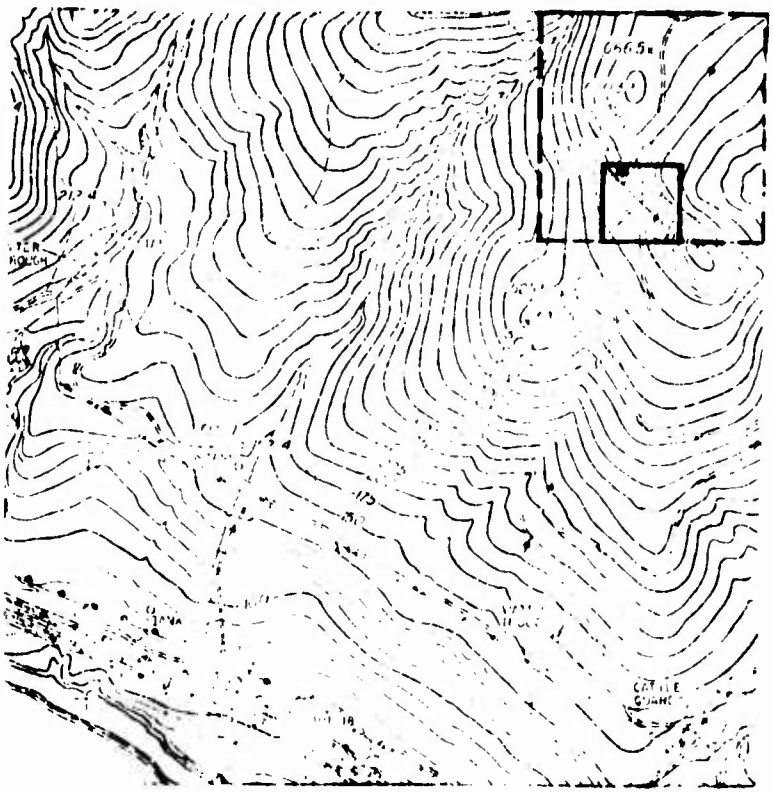
Vegetation Type ANNUAL GRASSLAND

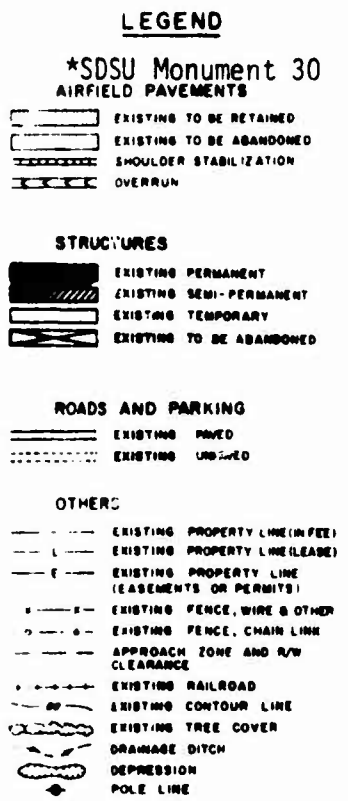
Remarks ROCK OUTCROPPINGS PRESENT

Slope Exposure UNDEFINABLE Mean Elevation of Quadrat 615'



Reference Directions 1.0 MI N OF COAST RD AND 2.9 MI S OF MIGUELITO RANCH; QUADRAT CA. 0.1 MI NORTH OF CATTLE CROSSING; GRAZED AREA.





Contour Interval=5 feet

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